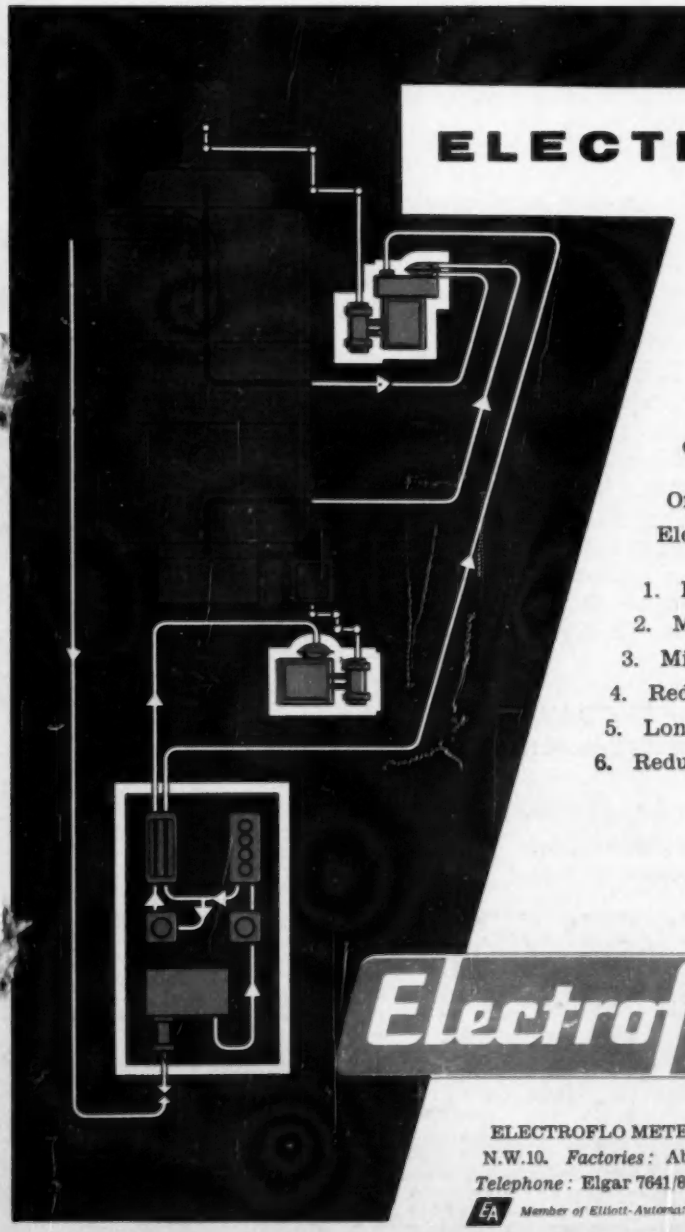
ENGINEERING AND
# BOILER HOUSE REVIEW

VOL. 73 NO. 6 • THE PIONEER STEAM JOURNAL • JUNE, 1958



## ELECTROFLO-SMOOT
## Automatic
## BOILER CONTROL

Fuel costs are high and steam remains industry's most expensive raw material.

One immediately practical, highly effective cost reducer is Electroflo Automatic Boiler Control. It provides :

1. Higher capacity with safety.
2. Minimum fuel consumption.
3. Minimum air pollution.
4. Reduced maintenance costs.
5. Longer operating periods between overhauls.
6. Reduced labour charges.

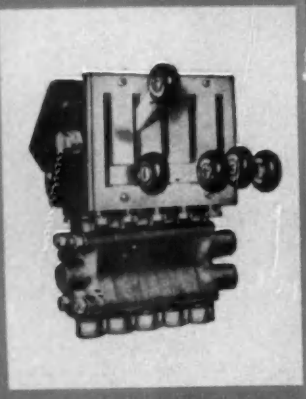
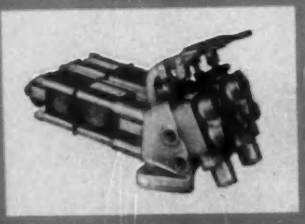
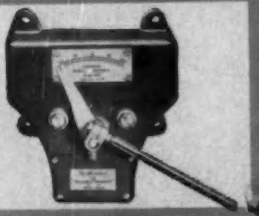
The accompanying illustration shows the system applied to a Shell-type boiler — typical of many hundreds of installations on boilers of all types and capacities. Ask for Publication No. S849.

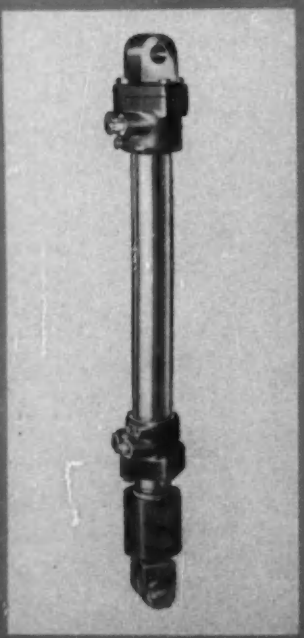
Electroflo

ELECTROFLO METERS COMPANY LIMITED. *Head Office :* Abbey Road, Park Royal, London, N.W.10. *Factories :* Abbey Road & Chase Estate, Park Royal and Maryport, Cumberland *Telephone :* Elgar 7641/8. *Grams & Cables :* Elflometa, London, Telex. Telex No. 2-3196.

*Member of Elliott-Automation Group*

BACKED BY A QUARTER OF A CENTURY OF
LOCKHEED HIGH-PRECISION HYDRAULICS



## UNITS THAT HAVE MADE HYDRAULIC HISTORY

Lockheed specialized development on the problems of specific industries has led to the evolution of the many units which are ideal for their particular purposes.

The units illustrated are typical of such specialization and represent the basis of the Lockheed Remote Control System. This was developed primarily for the control of Boiler Dampers and is to be found in the great majority of C.E.A. power stations.

It has also been widely adapted to many other industrial uses.

Lockheed control panels and cabinets incorporating these well-tried units, are extremely neat and workmanlike.

The units are arranged with express consideration of accessibility for inspection and maintenance.

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*For further details please write for pamphlets, and kindly mention this journal.*

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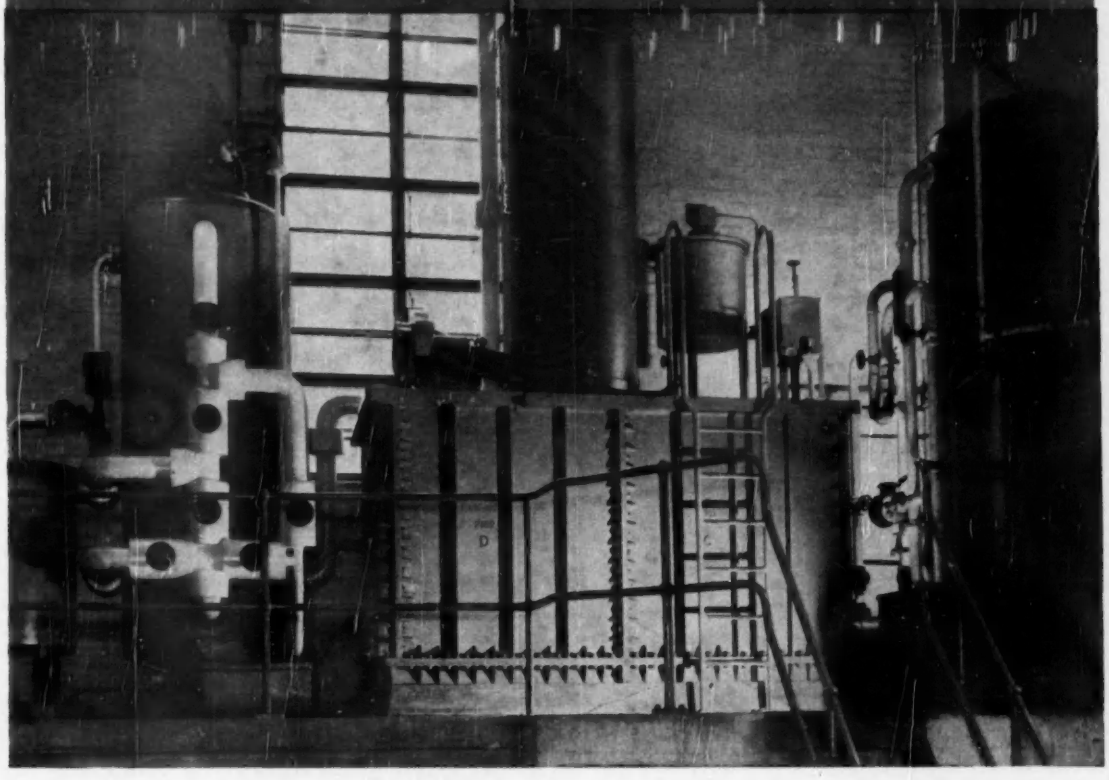

## Boiler Feed Water Treatment Plant

The Starvation/Base Exchange water treatment plant shown above produces a perfect boiler feed water with the following characteristics and advantages

- Reduced total dissolved solids.
- Zero hard water.
- Controlled alkalinity.
- No sludge.

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# * Use Refractory Concrete for Furnace & Boiler Foundations

## It saves money, labour, time and weight

- Has a high insulation value and affords maximum protection to the underlying structural foundations (9″ thickness has the same insulating value as 12″ of firebrick).
- Means monolithic construction and therefore cheap, quick and easy installation.
- Eliminates joints and reduces heat losses to a minimum.
- Is ready for service 24 hours after placing and also has a high cold strength.
- Is non-spalling under wide and sudden changes of temperature and stable under load up to 1300°C.

* REFRACTORY CONCRETE is the adaptable refractory material, made with CIMENT FONDU Aluminous Cement and crushed firebrick.

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*For Super-duty Refractory Concrete up to 1800°C use* ***SECAR 250*** *(White Calcium-Aluminate Cement). Write for details.*

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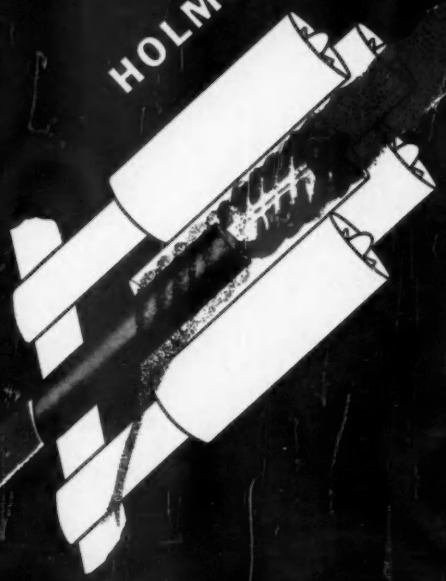
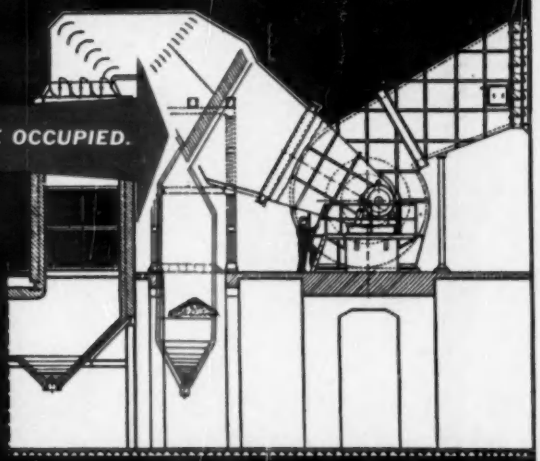
# HOLMES-ROTHEMUHLE MULTI-CELL CYCLONE DUST COLLECTOR



Many dust problems such as those caused by stack emissions from all types of boilers have been successfully solved by this inexpensive efficient mechanical type collector.

For full details please write for Publication No. 68



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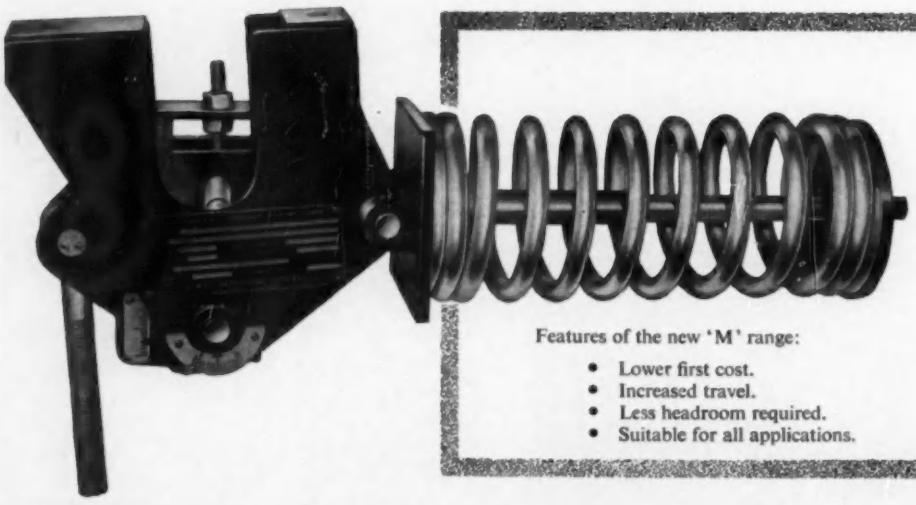
## a NEW range of Constant Support Hangers

The Vokes Genspring 'M' range of Constant Support Hangers is the culmination of long, practical experience and laboratory research by Vokes' engineers. Originally designed for rugged marine use, the 'M' range is more economical, both in application and first cost, and more compact than existing types; it also requires less headroom. Together with the other Vokes Genspring Constant Support Hangers, the new 'M' range provides the solution to any pipe suspension problem. *If you would like to know more, please send for full details of both types of Vokes Genspring suspension systems.*

## Vokes Genspring M range



Features of the new 'M' range:

- Lower first cost.
- Increased travel.
- Less headroom required.
- Suitable for all applications.

**Vokes Genspring SUSPENSION SYSTEMS**

**DEPT. J/5, VOKES GENSPRING LTD · GUILDFORD · SURREY**

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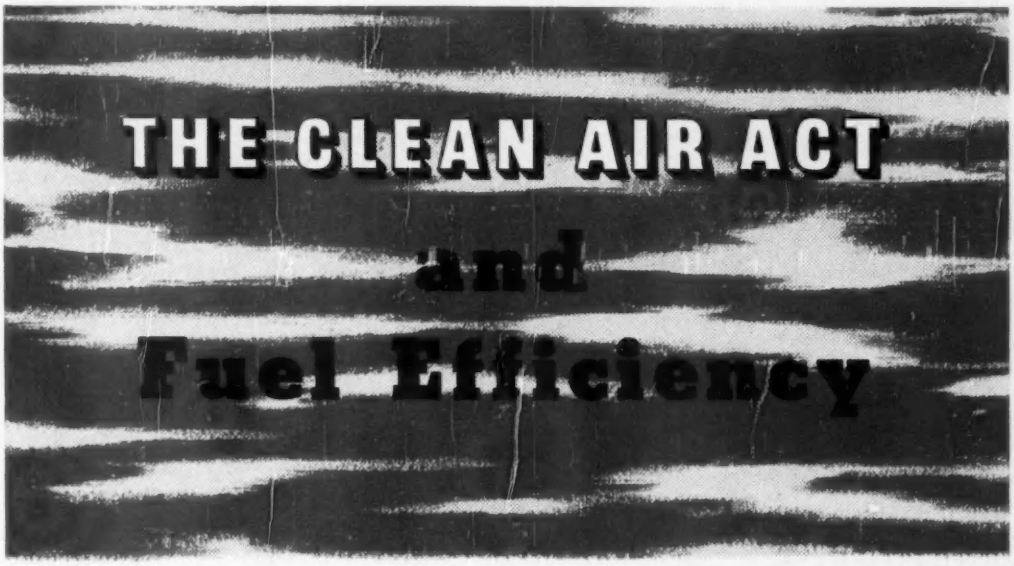


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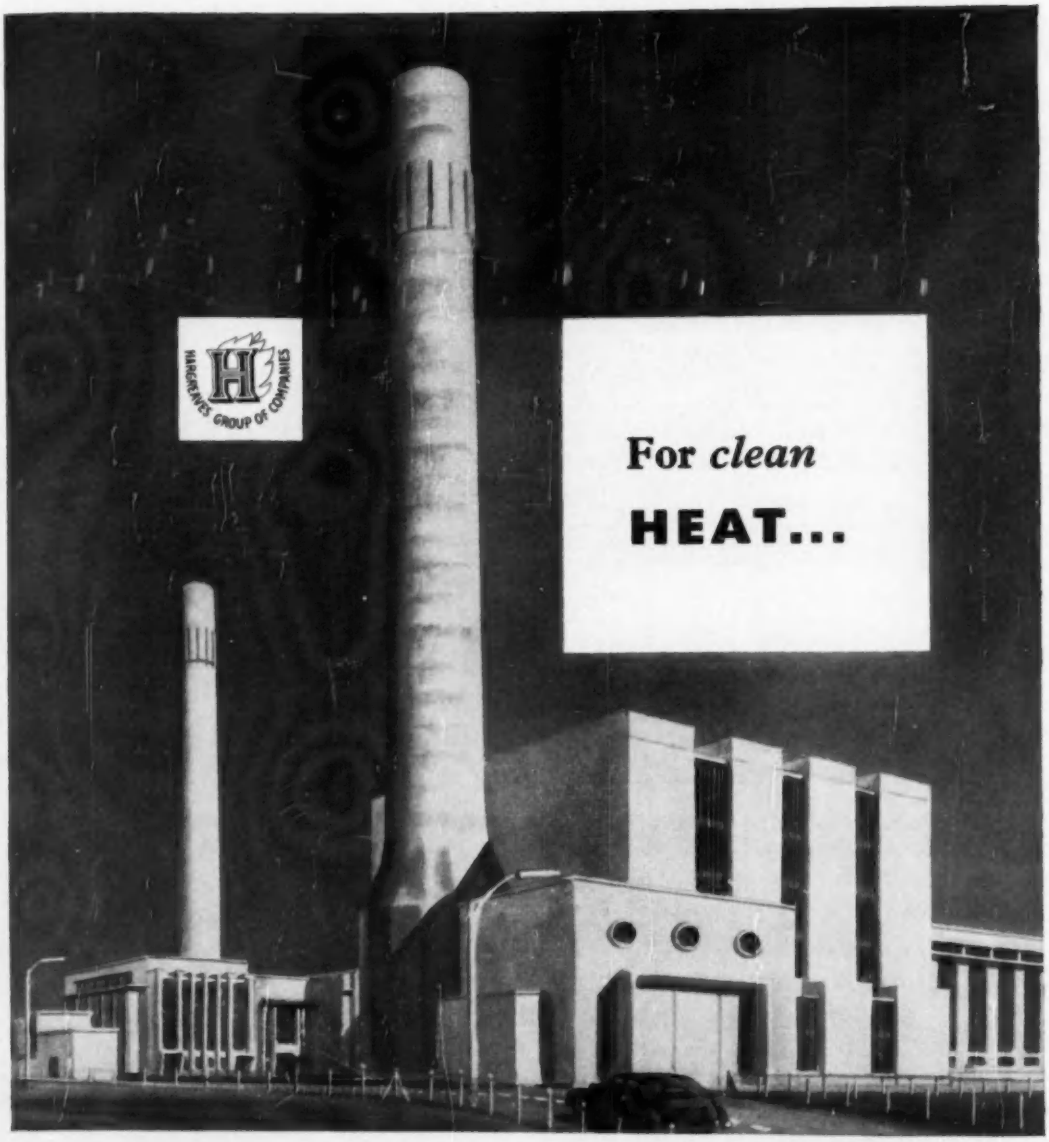
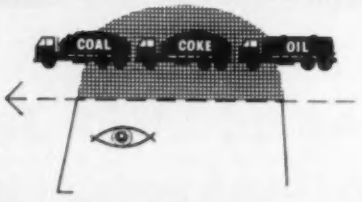



***...For CLEAN heat, there must be, as nearly as possible, complete combustion of suitable fuel.***

HARGREAVES operate a free Technical Advisory Service, backed by comprehensive laboratory facilities, to advise upon the appropriate fuel and potential economies in its use. In other words, how to get *more* heat for *less* money.

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**Consider the alternative.**

**The "Tornado" method of man-cooling definitely encourages production all the time. Man-cooling fans deliver, for as long as is necessary, a brisk, cooling air current which relieves excessive body heat and improves breathing conditions. Designed particularly for use in the "heavy" trades, they combine an easy portability with robust construction—two essential characteristics.**

**If your concern is for workers in iron and steel works, foundries, boiler houses, gas retort houses, glass works or "lighter" industries where efficiency is bound up with the maintenance of comfortable working conditions then you should see Publication No. 9/10.**

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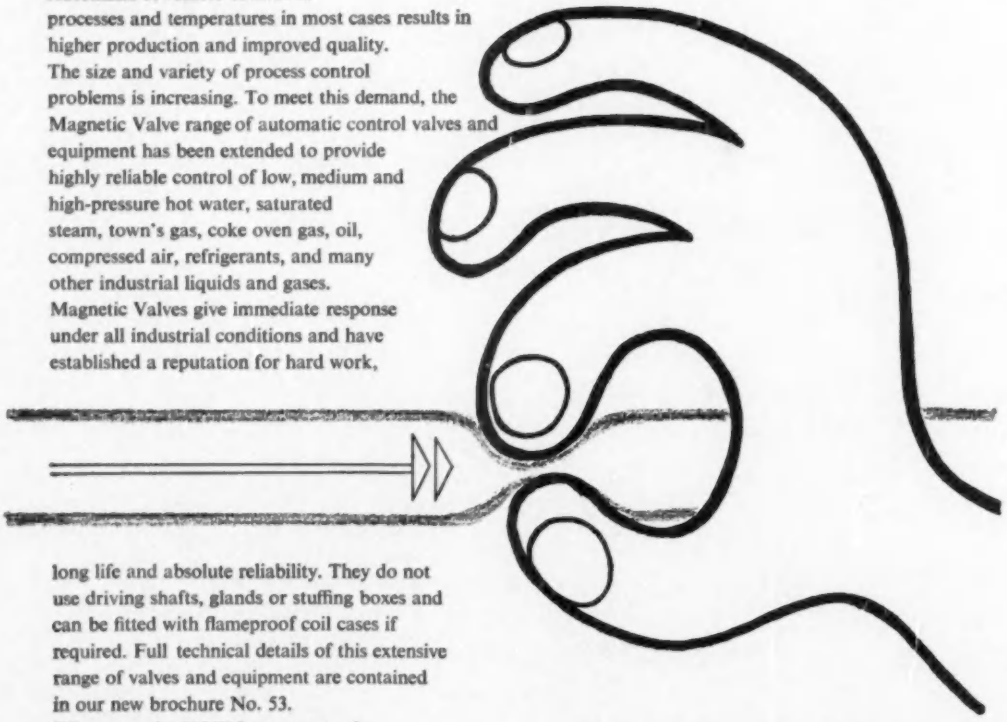
Automatic or remote control of processes and temperatures in most cases results in higher production and improved quality. The size and variety of process control problems is increasing. To meet this demand, the Magnetic Valve range of automatic control valves and equipment has been extended to provide highly reliable control of low, medium and high-pressure hot water, saturated steam, town's gas, coke oven gas, oil, compressed air, refrigerants, and many other industrial liquids and gases. Magnetic Valves give immediate response under all industrial conditions and have established a reputation for hard work,



long life and absolute reliability. They do not use driving shafts, glands or stuffing boxes and can be fitted with flameproof coil cases if required. Full technical details of this extensive range of valves and equipment are contained in our new brochure No. 53.
Why not write *NOW* for your copy?

✳ **If you have a problem involving the design, installation and satisfactory operation of automatic control equipment, you'll find our Technical Advisory Service of great benefit.**

Magnetic 'R' Type
Single-beat Stop Valve with
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Magnetic 'R' Type
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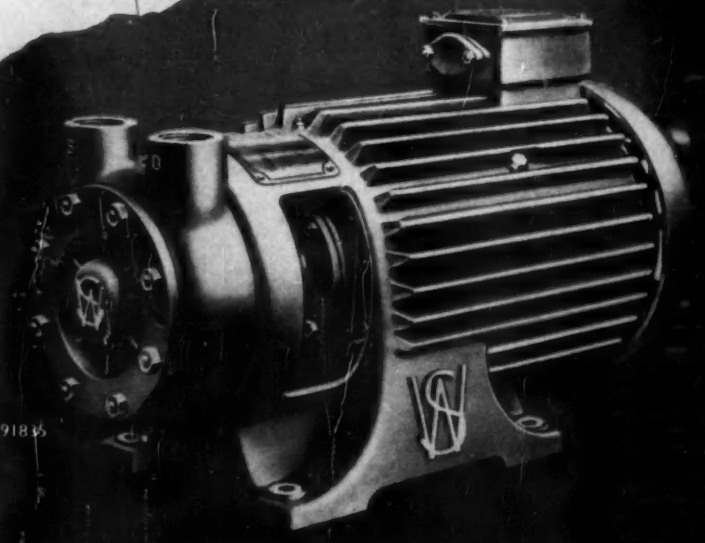
MV3

| Total Head in Feet | |
|---|---|
| 300 | PUMP R P M B H P |
| 275 | PUMP R P M B H P |
| 250 | PUMP R P M B H P |

# these heads on single stage pumping

A CHEAPER—SIMPLER METHOD OF PUMPING SMALL CAPACITIES AT HIGH HEADS FOR BOILER FEED SERVICE etc.



Patent No. 591835

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for clean low-viscosity liquids

Plus the outstanding advantages of MONOBLOC CONSTRUCTION

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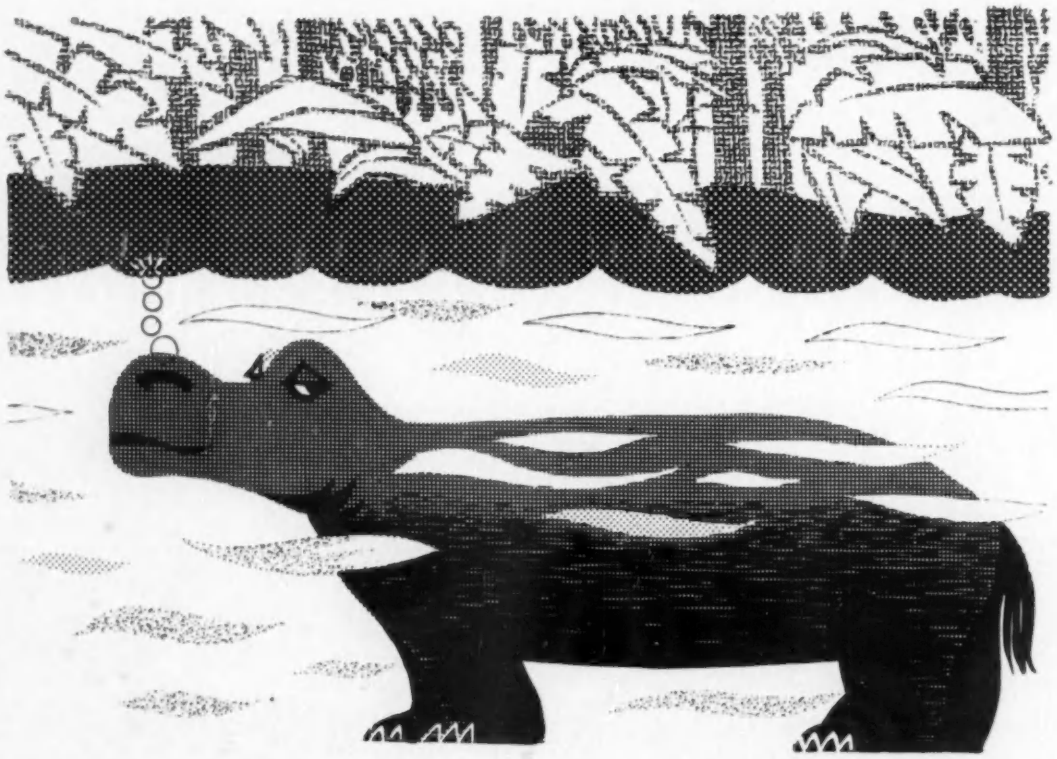

# He would merely submerge and forget

Unfortunately corrosion in steam-raising plant cannot be forgotten. It is too costly and damaging in its effects. "Apexior Number 1" is the most economical, *sure* safeguard against corrosion on surfaces in contact with wet temperatures between 175° and 1000°F. Two coats of "Apexior Number 1"—mechanically or brush applied—constitute absolute protection for at least 12 months. After the initial treatment only one coat is necessary. Subsequent descaling is a much simplified process because scale is less, looser and more easily removed from Apexiorised surfaces.

In certain industries it is a most important advantage of "Apexior" that it does not affect the water by taste, taint or smell. For over 50 years, "Apexior Number 1" has been put to work in all types of boilers of leading manufacturers with absolute satisfaction. Let experience be *your* guide; send for a copy of the "Apexior Manual".

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**"APEXIOR NUMBER 1" PREVENTS CORROSION IN STEAM-RAISING PLANT**

But for cold-wet surfaces up to 125°F.—use "APEXIOR NUMBER 3"

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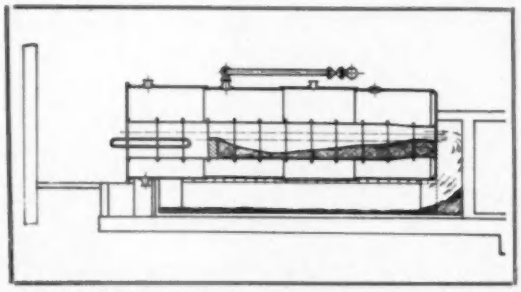
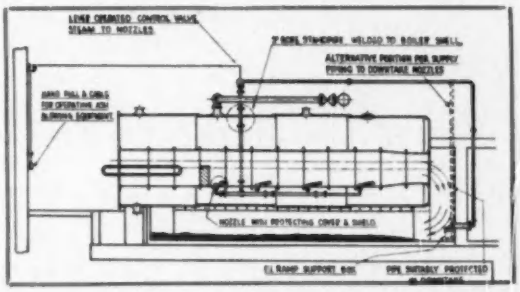
# IT COSTS TOO MUCH!

## TO IGNORE MODERN BOILER FLUE CLEANING METHODS



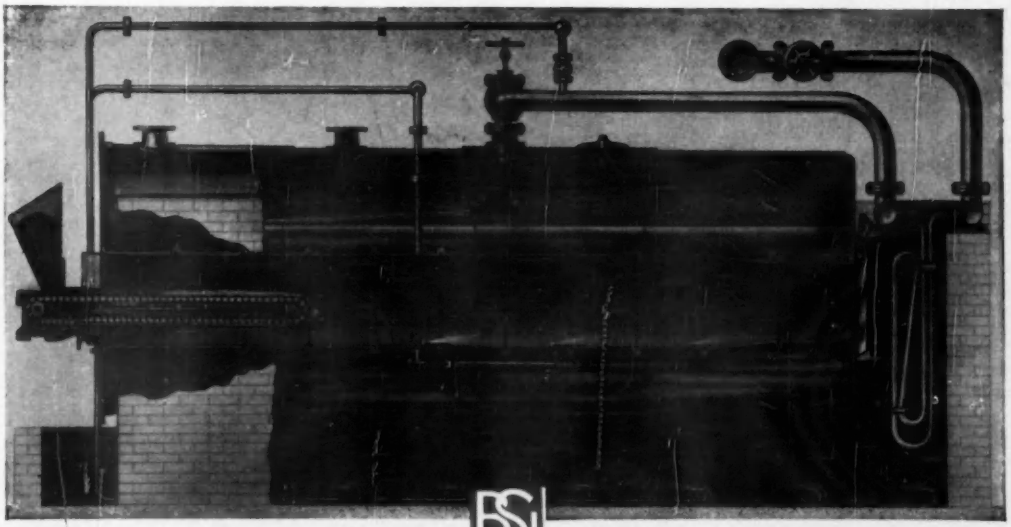
STOP THIS WASTE AND INEFFICIENCY—

ash deposit in the furnace tubes is the cause.



WITH 'BOLTON-GRAY' ASH BLOWING EQUIPMENT *(MODEL A)*

ash is blown clear at will, maintaining the full designed heating surfaces.



MODEL B maintains the same condit ons in the furnace tubes as Model A but with additional application to the flame bed, side flues, economiser chamber and final removal of ash to settling chamber. Boilers fitted with Model B can remain in service for periods up to twelve months without shutdown. Please write for brochure.

***For clean air and reduced costs fit***

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**CAPOSITE**
single layer insulation

'no undercoat'
cuts application time
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This 'one-layer' insulation is made from the uniquely long fibred South African asbestos known as Amosite. It has a negligible breakage loss in transportation or storage, and its inherent strength enables it to be handled efficiently and without mess in large size blocks and pipe section diameters and lengths.

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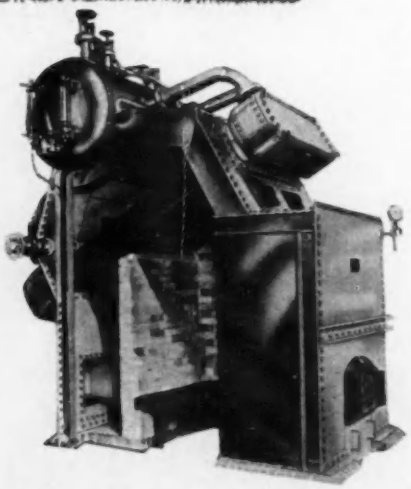

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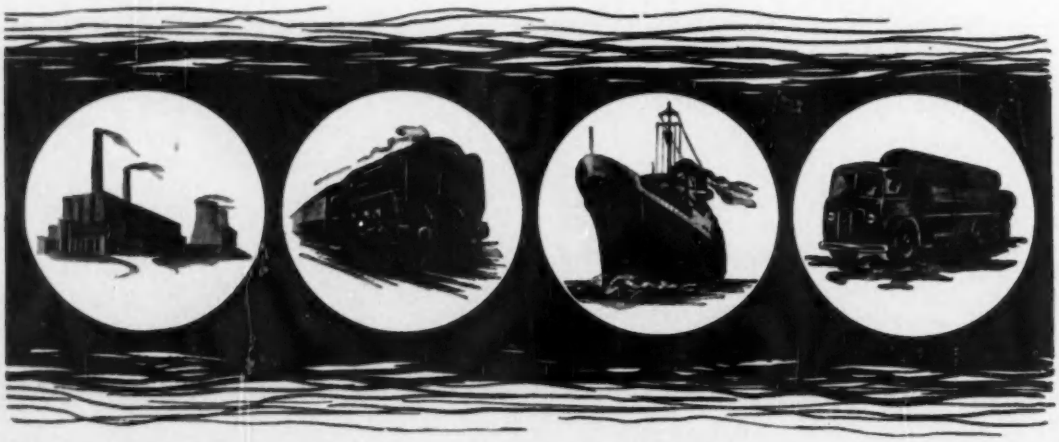

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STEAM USING PROFIT can be slipping through your fingers if you don't make full use of raw materials you've already paid rather highly for. For example. It is always worth while looking again at any of your processes to see whether they can be run at a lower temperature. Our experience is that many can be, without loss of production, and occasionally even with an improved product.

That's one side of it : keeping temperature down to the minimum. The other side is to see whether you can't raise the temperature of your processing medium or of your material to be processed for no extra cost. Again, our experience, etc. etc.

It seems only common sense to exploit, in as many ways as possible, the same quantity of heat. There can be various ways of doing it, sometimes by the installation of a quite simple heat exchanger whose capital cost is rapidly recovered in fuel savings and in shorter processing time.

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If you have doubts as to whether you're spending any money like water, we'll be happy to try and turn your waste into liquid assets.

And if we *don't* think it is possible, we'll say so. No point in wasting your time or ours.

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*Please send details of flash steam recovery*

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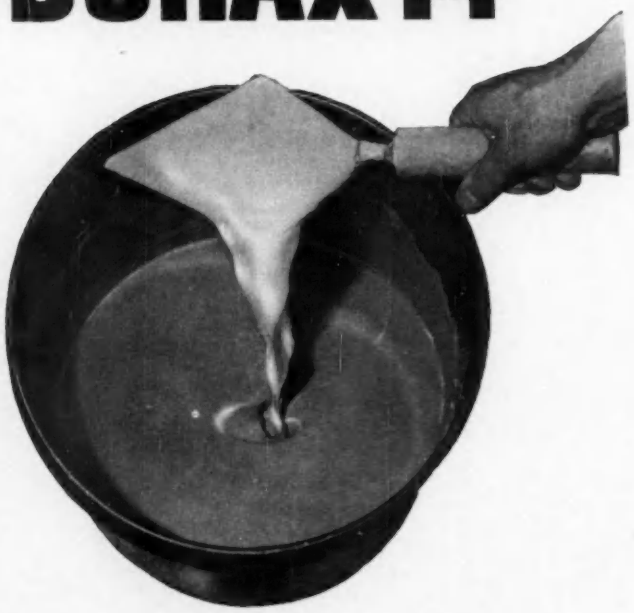

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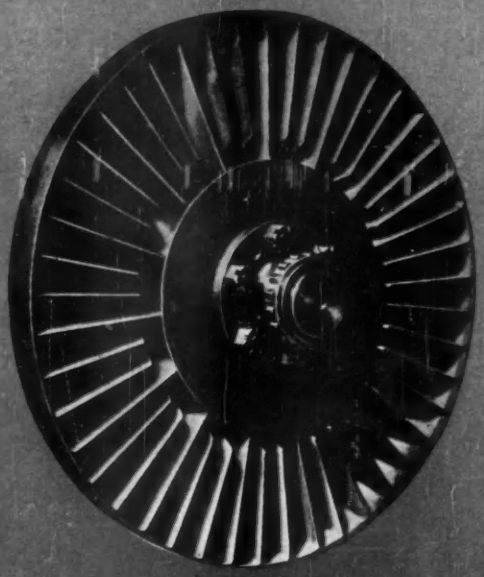

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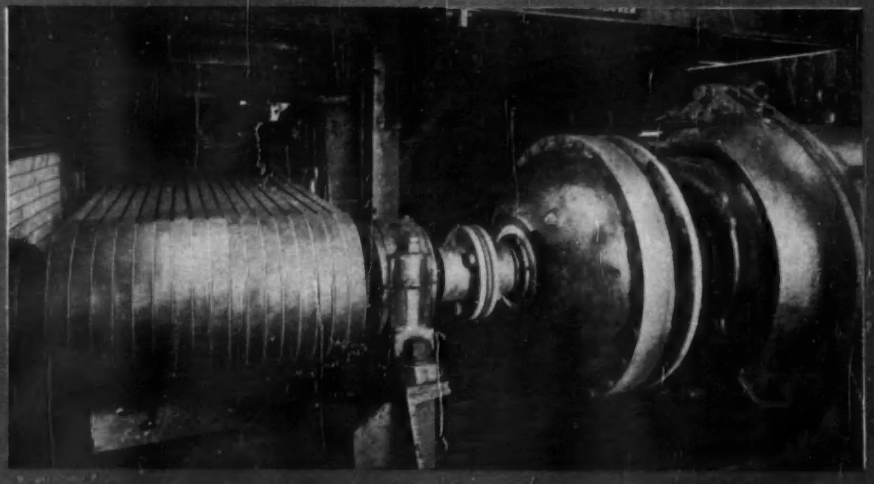

200 h.p. British Jeffrey-Diamond Crusher, as supplied by Babcock and Wilcox Ltd.

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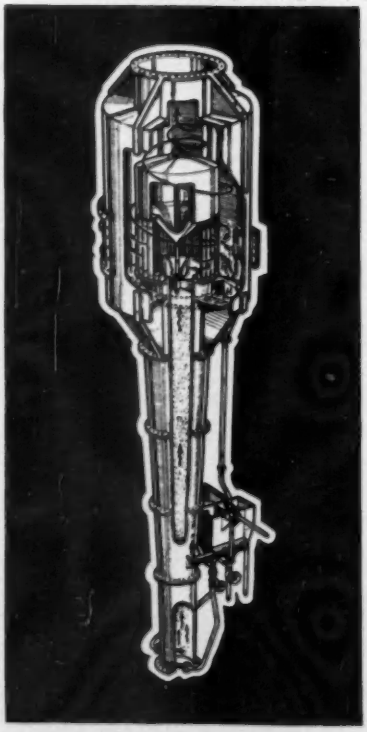

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of saving it
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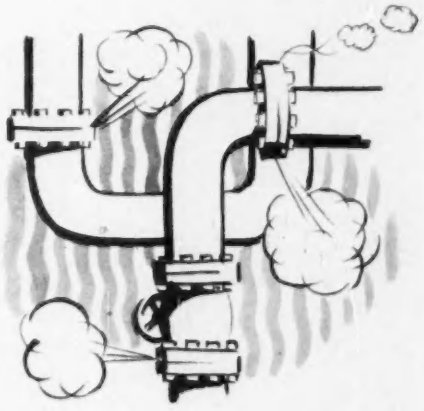

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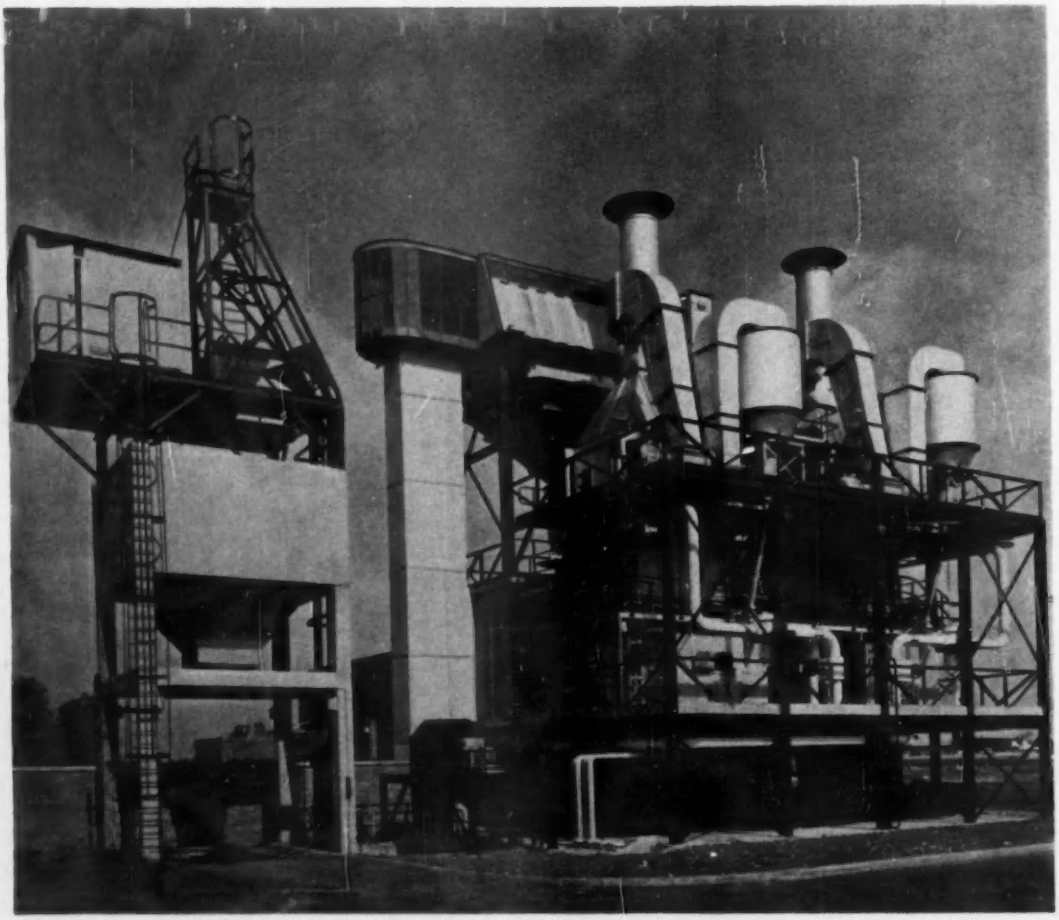

*Two 15 million B.T.U.s/hr. high temperature LA MONT Hot Water Boilers installed in Bedfordshire to the design and to the requirements of the Chief Mechanical and Electrical Engineers Division of The Ministry of Works.*

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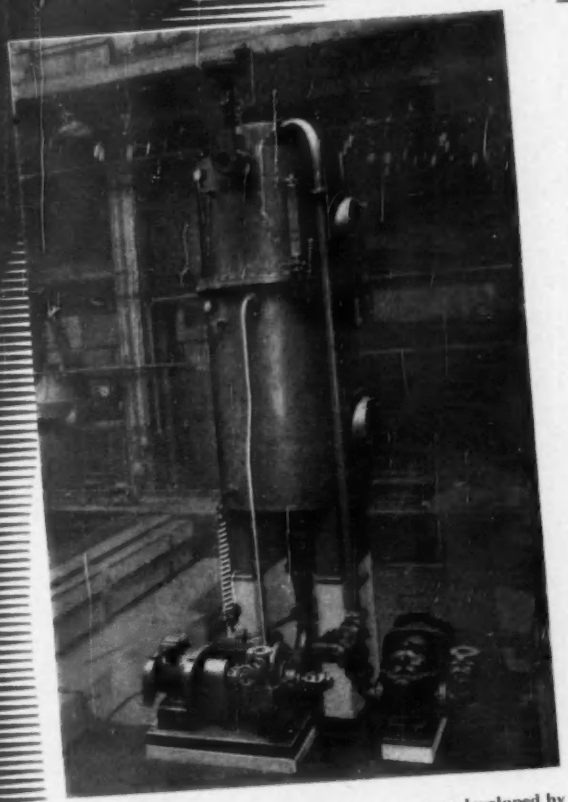

*Pressure Type Deaerator for 120,000 lb/hour*

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The recirculating deaerator developed by Hick Hargreaves provides a simple and dependable means of preventing corrosion by reducing the oxygen content of the feed water. Effective deaeration is assured under all conditions of flow, no matter how wide or rapid the fluctuations in the feed rate, whilst the absence of floats and spray valves ensures great reliability. Three types are available. The Straight Spray Type is suitable for handling feed water from 130°F (55°C) to 200°F (95°C) and requires no heating steam for its operation. The Direct Contact Heating Deaerator accomplishes the dual purpose of deaerating and heating cold water up to a maximum outlet temperature of 180°F (82°C).

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Standard designs for all types are available with capacities from 20,000 lb/hour (10,000 kgs/hour) to 450,000 lb/hour (200,000 kgs/hour).

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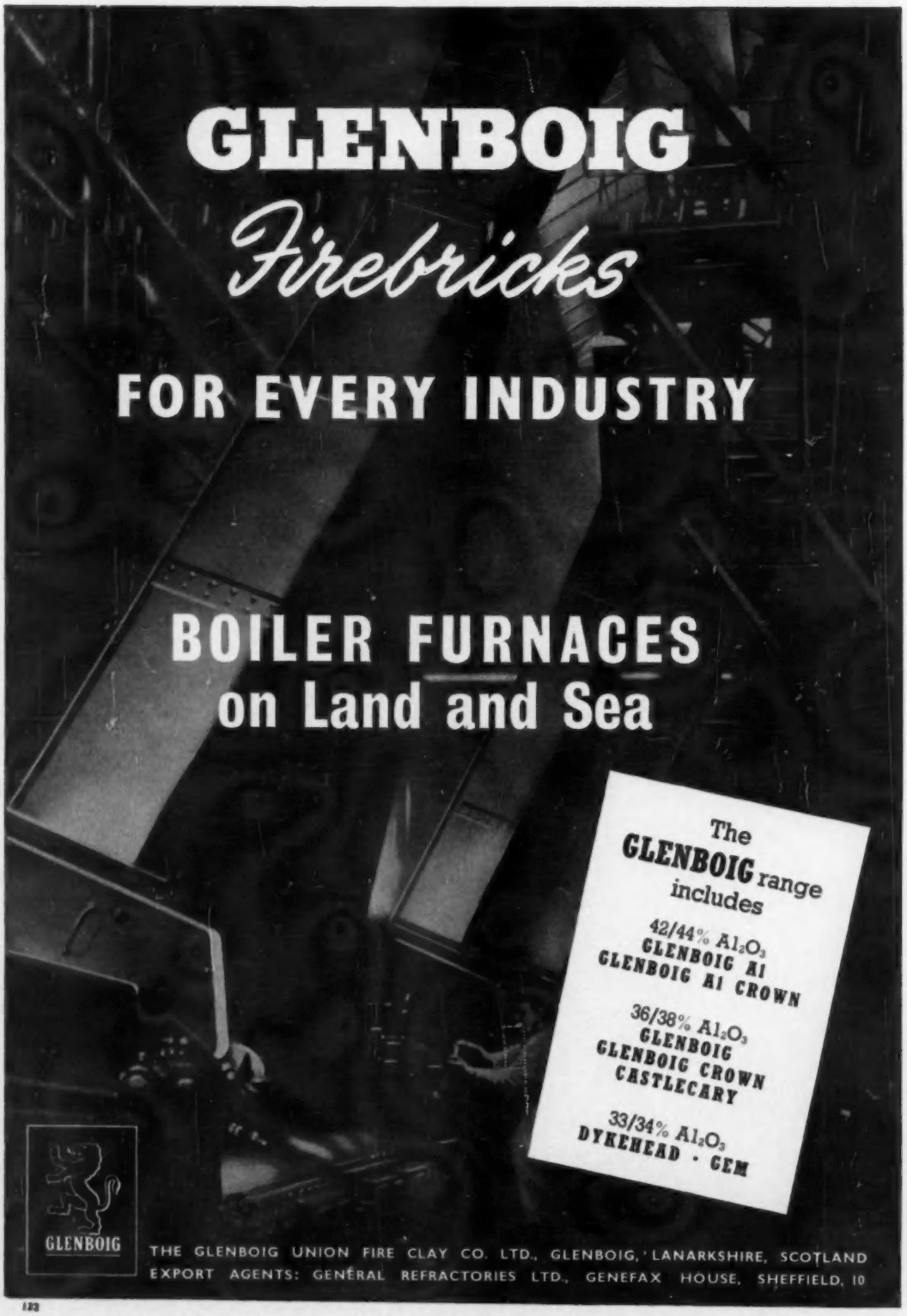
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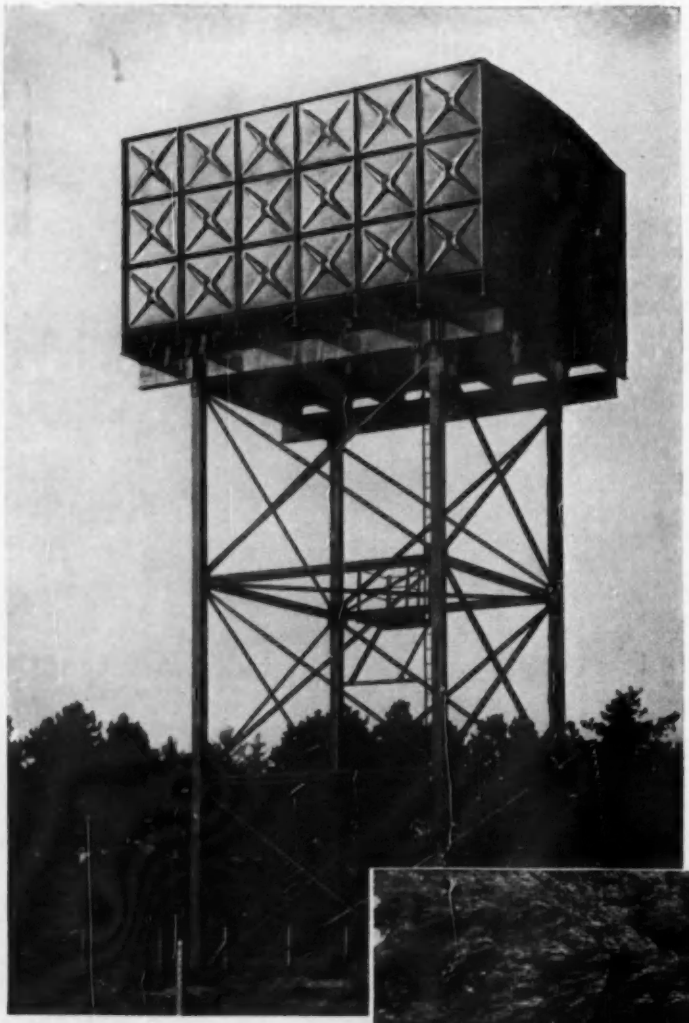
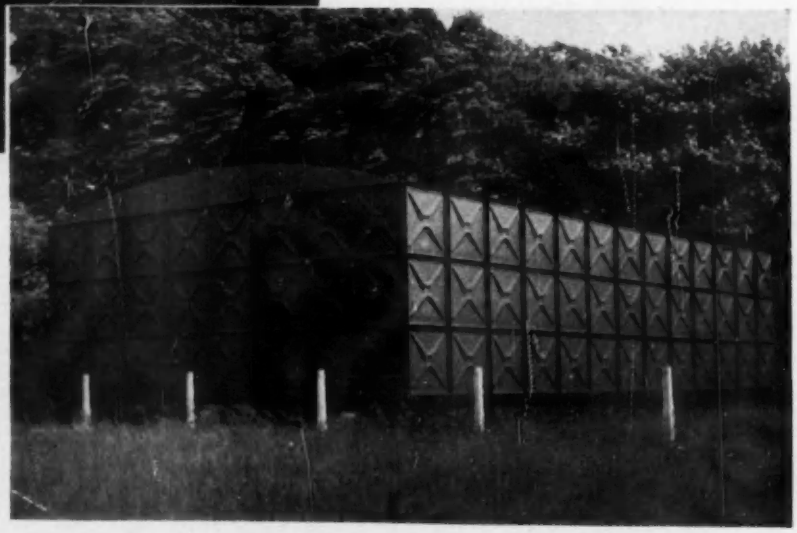


*Braithwaite*

# PRESSED STEEL SECTIONAL TANKS



Braithwaite Pressed Steel Tanks with external flanges throughout comply with British Standard 1564 : 1949. The sectional method of construction enables tanks with an unlimited range of capacities to be provided. Suitable for the storage of most liquids and viscous substances, they can be economically transported and erected in positions inaccessible to other forms of construction. They can also be increased in size when additional capacity is required. Illustrated brochure will be sent on application.

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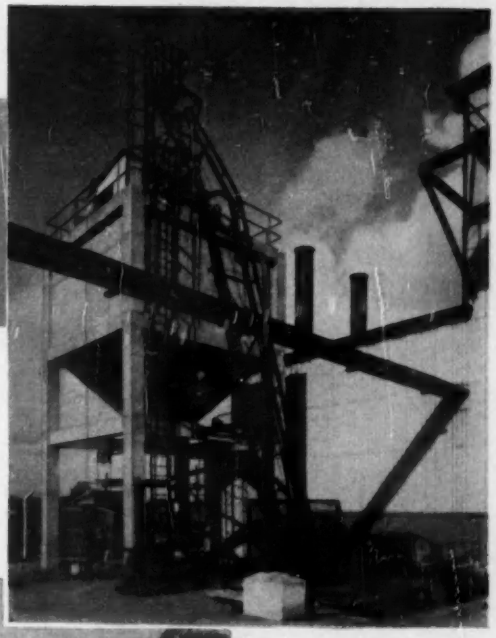
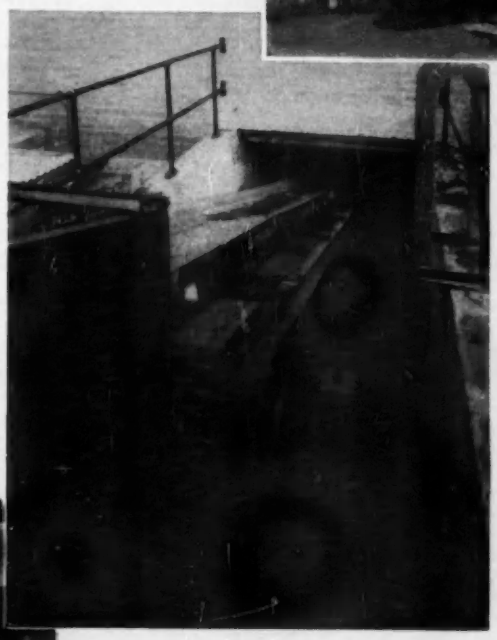
# JOHN THOMPSON
## *Submerged Ash Conveyors*



In the John Thompson Ash Conveyor the ash from the boiler furnaces falls through water to a submerged belt conveyor. The ash is immediately quenched, and no dust can escape. The conveyor works at low speeds and requires very little power to drive it. Wear and upkeep are practically nil.

*Ash handling from the discharge end of the conveyor to the storage hopper.*



*The discharge end of the submerged conveyor belt emerging from the trough.*

*The trough with submerged belt, showing the ash chutes from the boilers.*

JOHN THOMPSON CONVEYOR COMPANY
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*by—* **B.V.C**

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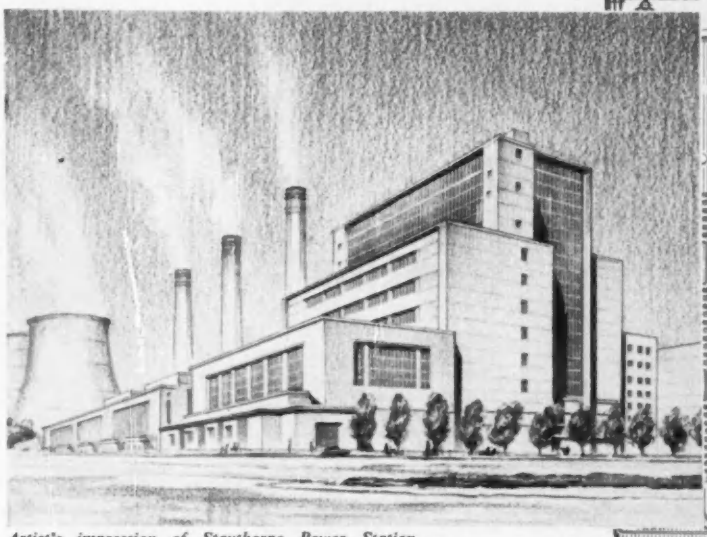
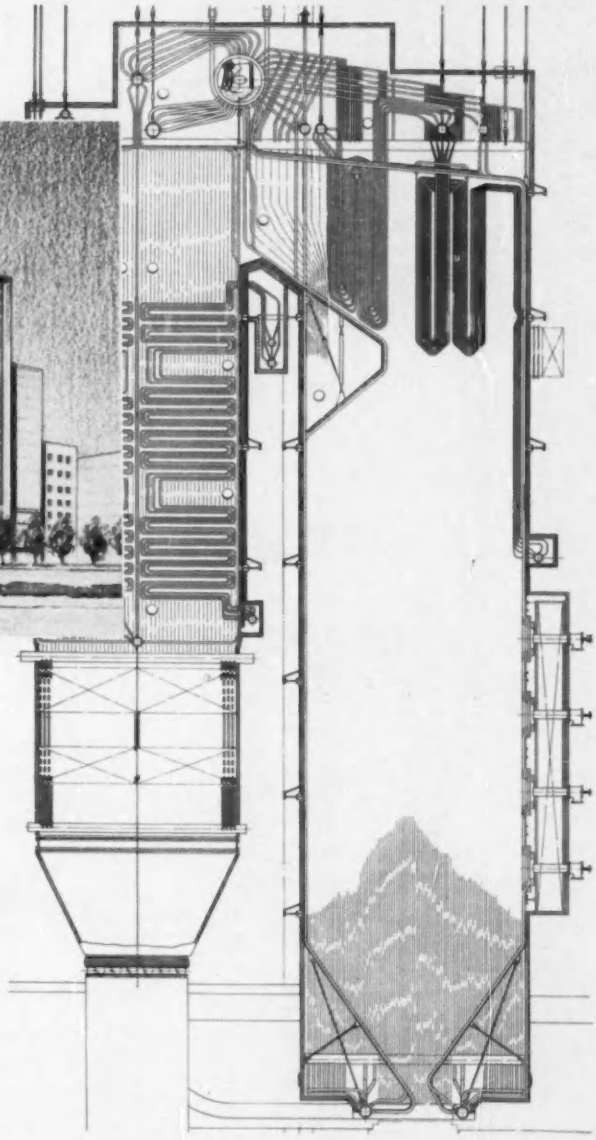


*Artist's impression of Staythorpe Power Station.*



# 860,000 lb/hr. at STAYTHORPE "B" Power Station

(Central Electricity Authority).

Brown-Riley Steam Generators ranging from 150,000 lb/hr. to 860,000 lb/hr. capacity are being installed in numerous important Power Stations for the Central Electricity Authority.

Staythorpe "B" will have three 860,000 lb/hr. units complete with Brown-Riley pulverised fuel equipment and all the usual ancillary plant. Many much smaller industrial boilers are being built at Whitecrook for hospitals, factories and local authorities both at home and overseas.

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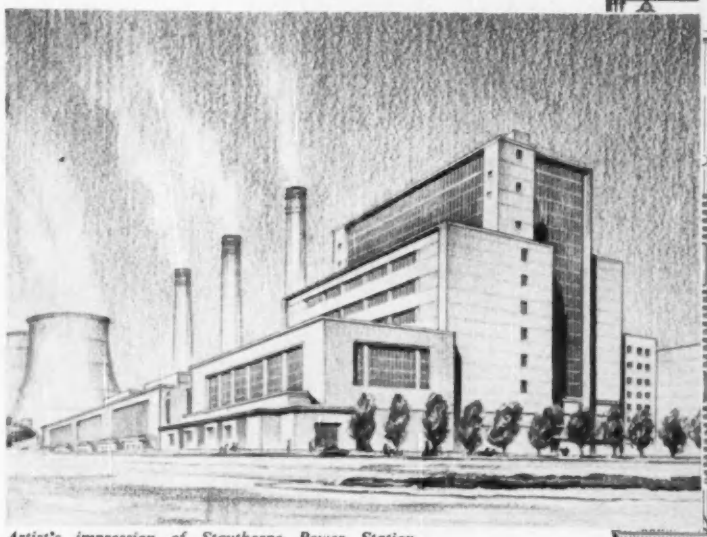

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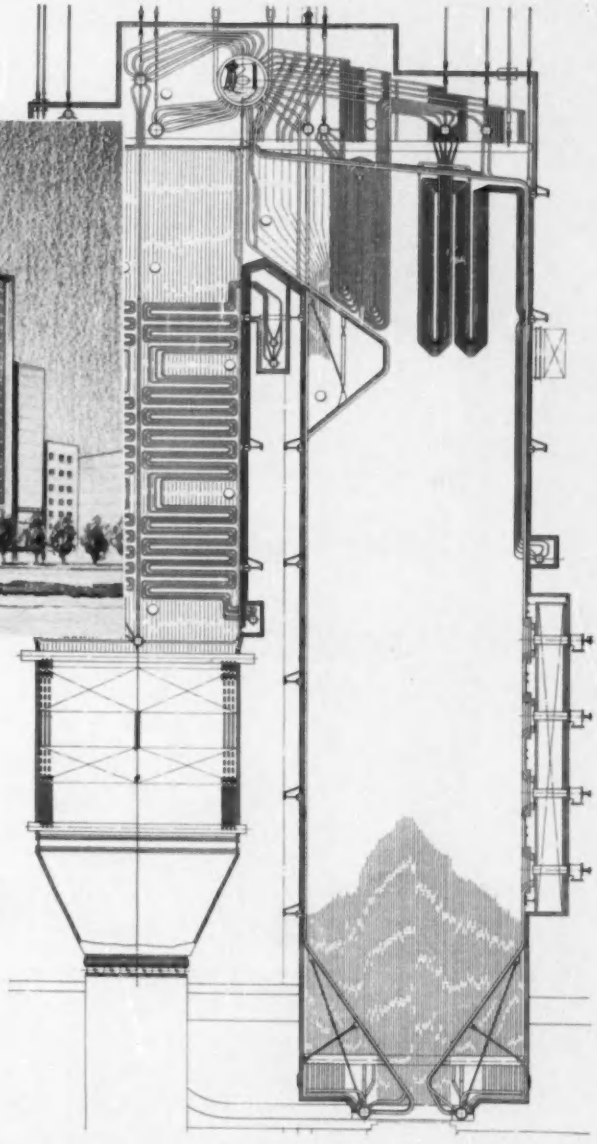

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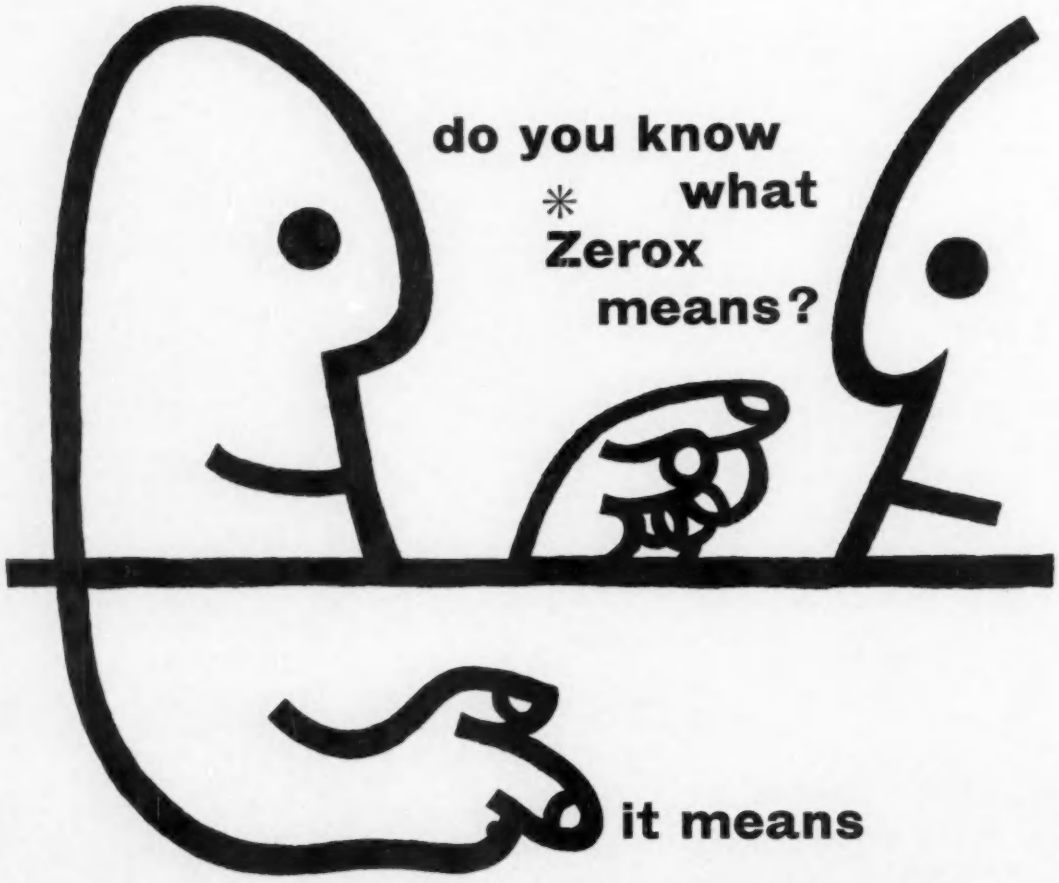


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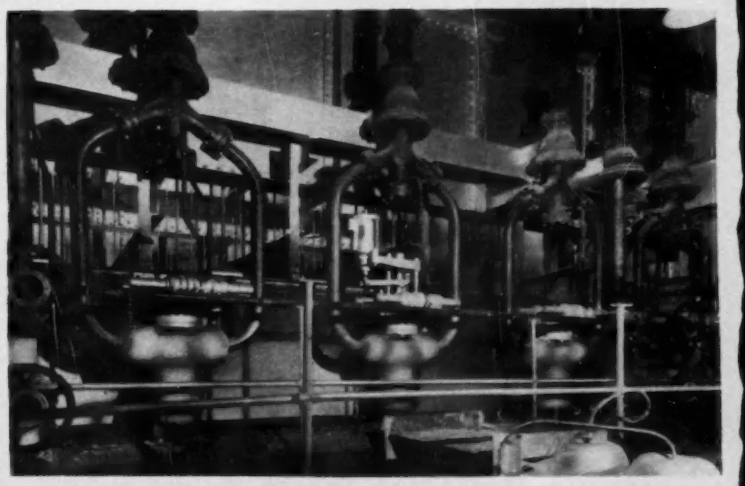

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# THORPE MARSH

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# Removing 12 tons of dust an hour

At the new Thorpe Marsh power station, to be built for the Central Electricity Generating Board, Simon-Carves have been entrusted with the design and construction of the electro-precipitation plant which will have what is believed to be the heaviest duty yet proposed for precipitators on a single boiler unit anywhere in the world.

The unit will have an output of 550 MW and the boiler is expected to produce more than one and a half million cubic feet of flue gas per minute. The plant will remove fine dust, which would otherwise pollute the atmosphere, at a rate of about 12 tons an hour.

**PREVENTING AIR POLLUTION**

| MW per unit | STATION | Gas volume per boiler (cubic feet per minute) |
|---|---|---|
| **550** | **THORPE MARSH** | **over 1,500,000** |
| 120<br>120<br>100 | PADIHAM 'B'<br>DRAKELOW 'B'<br>WILLINGTON 'A' | over 300,000 |
| 60<br>60<br>60 | HAMS HALL 'C'<br>BOLD 'B'<br>ROGERSTONE | over 200,000 |
| 60<br>30<br>30<br>30 | CHADDERTON 'B'<br>FLEETWOOD<br>HACKNEY 'B'<br>HUNCOAT | over 100,000 |

*This table of Simon-Carves precipitators for power stations of the Central Electricity Generating Board emphasises the magnitude of the Thorpe Marsh project. High average efficiency on plants already tested enables Simon-Carves to accept this great responsibility with complete confidence.*

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Stage-nozzle automatic condensate trap, type B.K.

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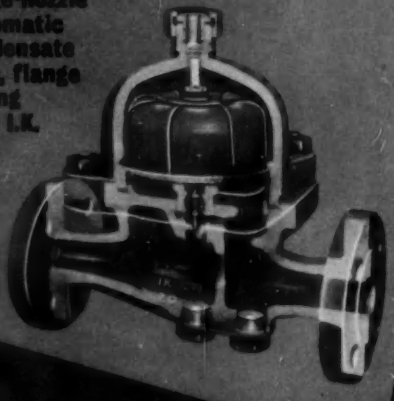
Stage-nozzle automatic condensate trap, flange fitting type I.K.



*We shall be pleased to send illustrated leaflets and full details of all GESTRA equipment.*

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# *modern methods of condensate removal by*

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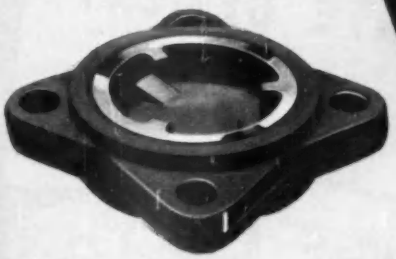
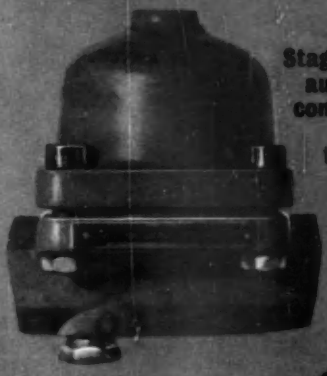
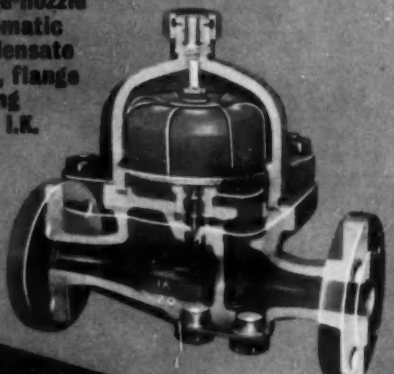


**Stage-nozzle automatic condensate trap, type W.K.**

**Stage-nozzle automatic condensate trap, type B.K.**



**Stage-nozzle automatic condensate trap, flange fitting type I.K.**



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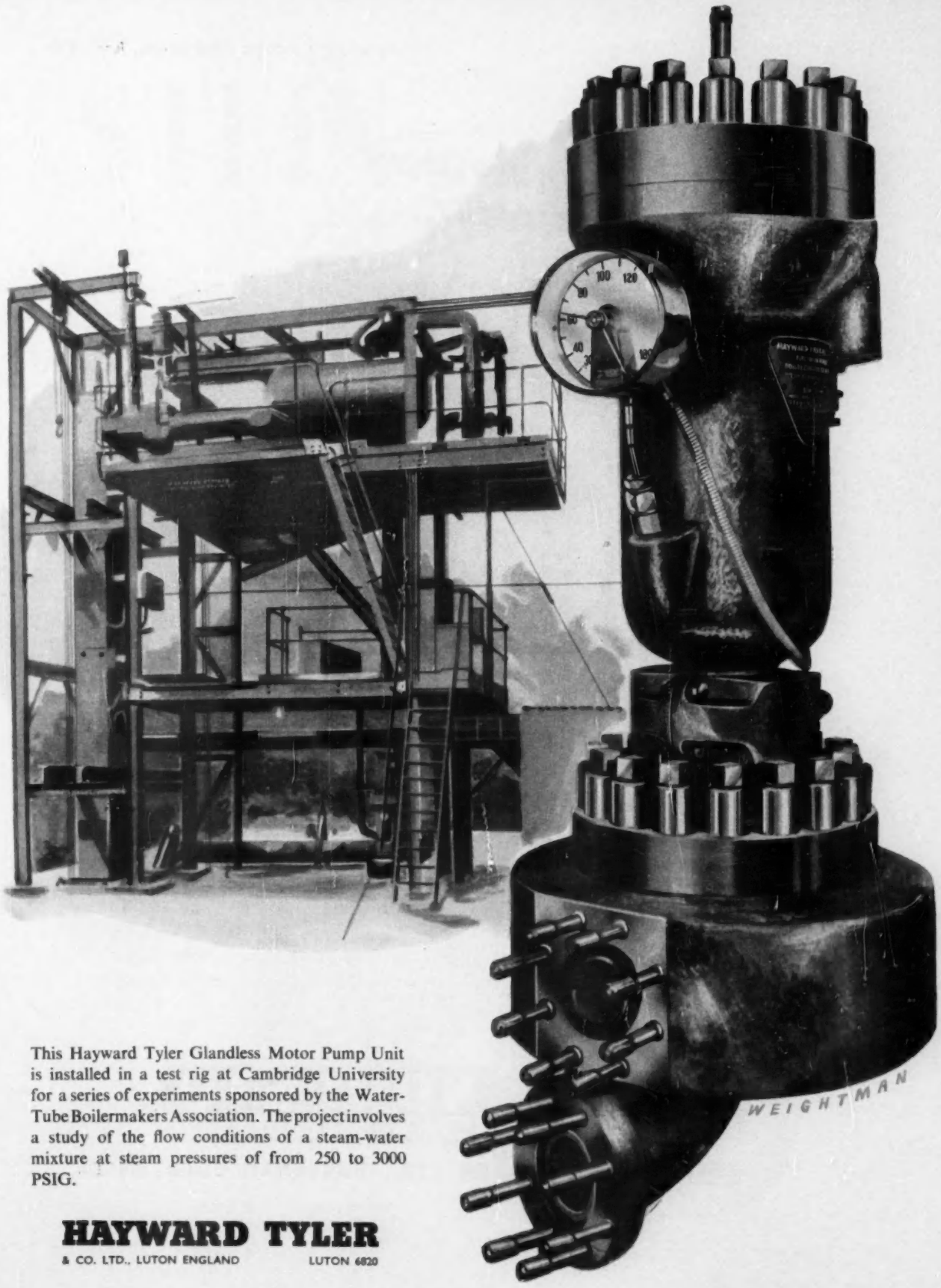


This Hayward Tyler Glandless Motor Pump Unit is installed in a test rig at Cambridge University for a series of experiments sponsored by the Water-Tube Boilermakers Association. The project involves a study of the flow conditions of a steam-water mixture at steam pressures of from 250 to 3000 PSIG.

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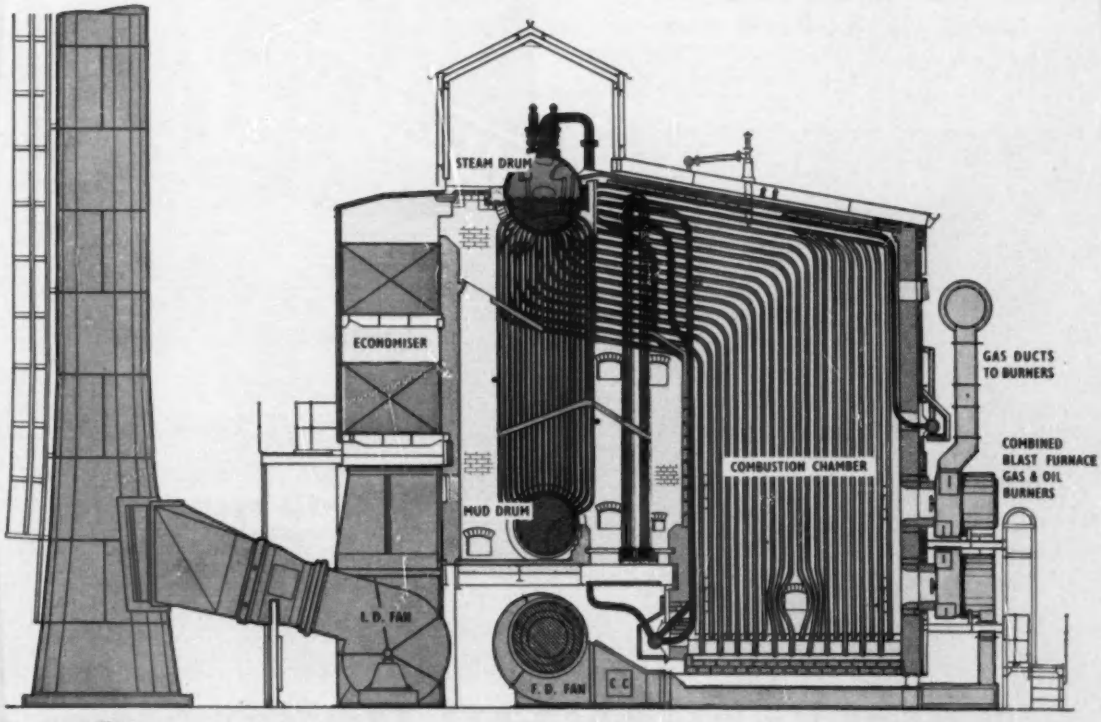
*Below is shown the arrangement of a John Thompson 'Integral' boiler fired by blast furnace gas or oil at Messrs. Stewarts and Lloyds, Bilston. Above, one of the boilers is seen during erection.*

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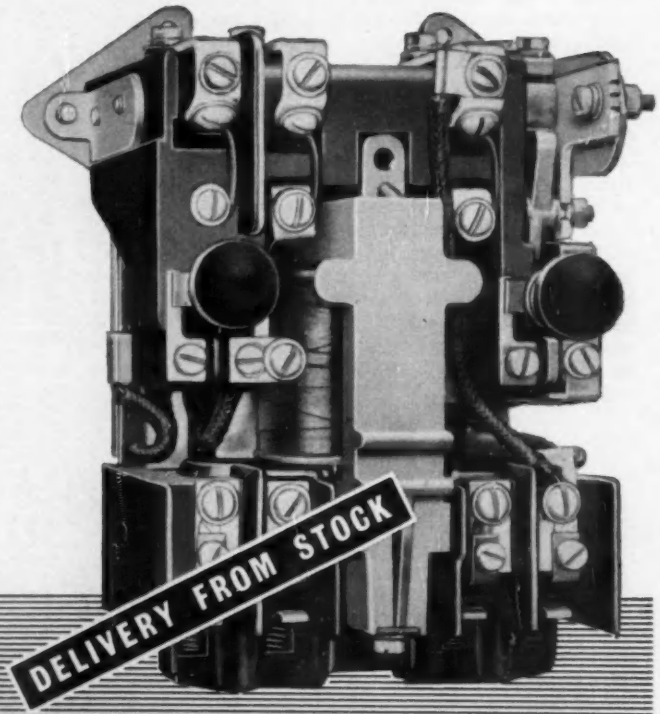
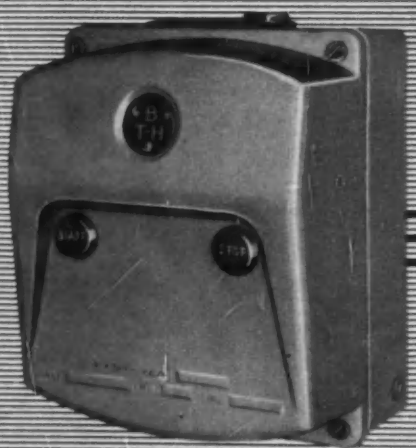


DELIVERY FROM STOCK



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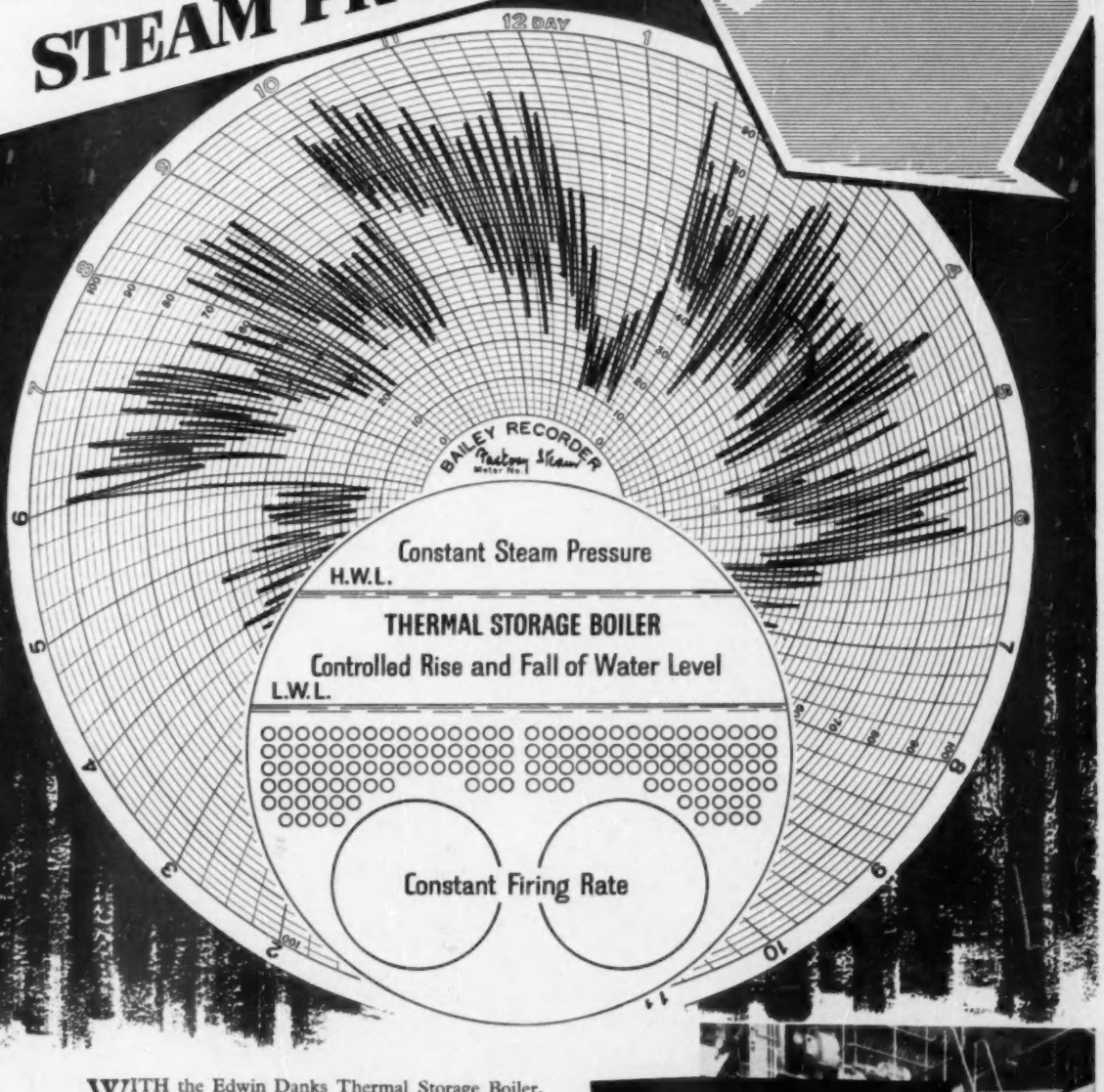


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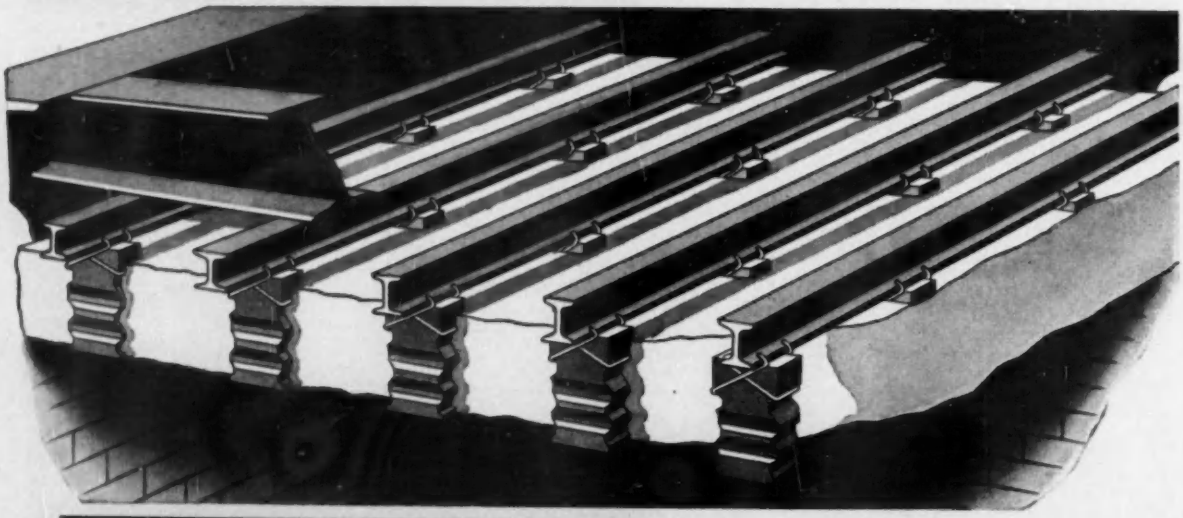
*Full details of each grade are available on request.*



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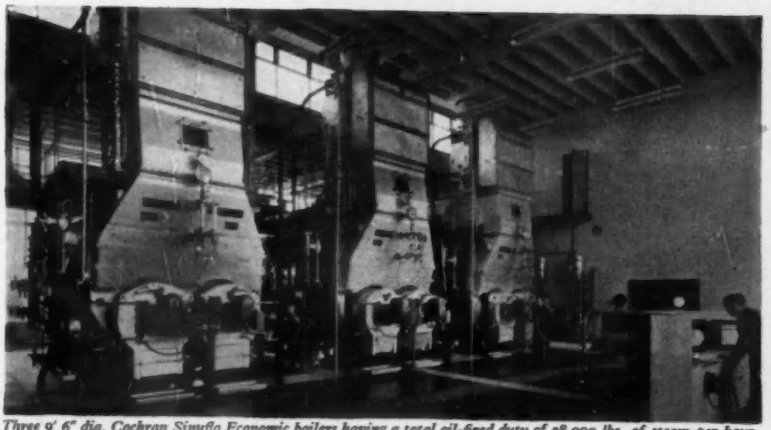
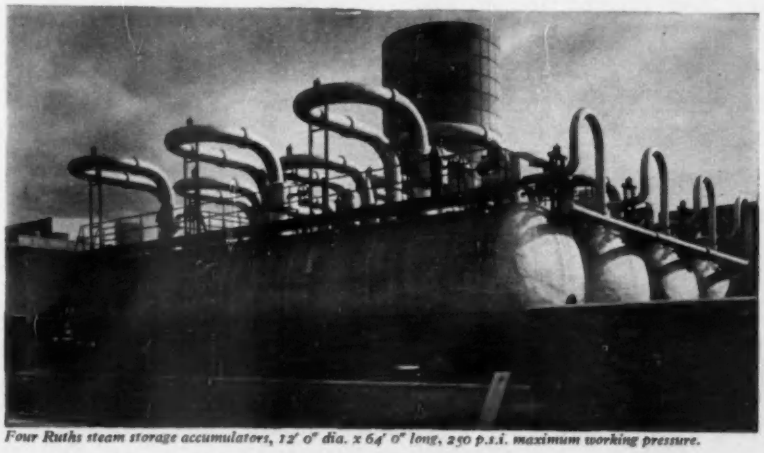


*Three 9' 6" dia. Cochran Sinuflo Economic boilers having a total oil-fired duty of 38,000 lbs. of steam per hour at 250 p.s.i.*



*Four Ruths steam storage accumulators, 12' 0" dia. x 64' 0" long, 250 p.s.i. maximum working pressure.*

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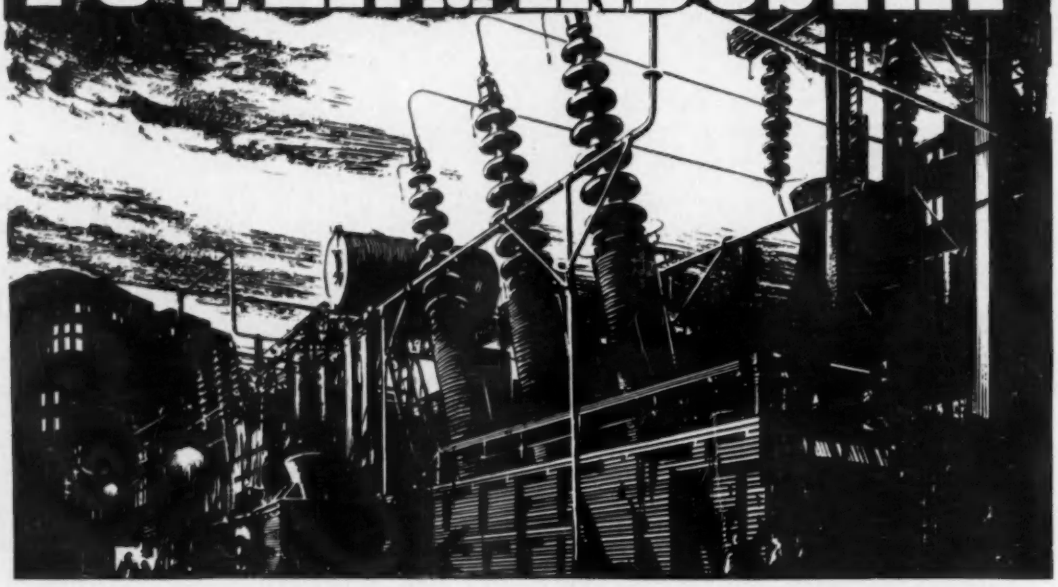

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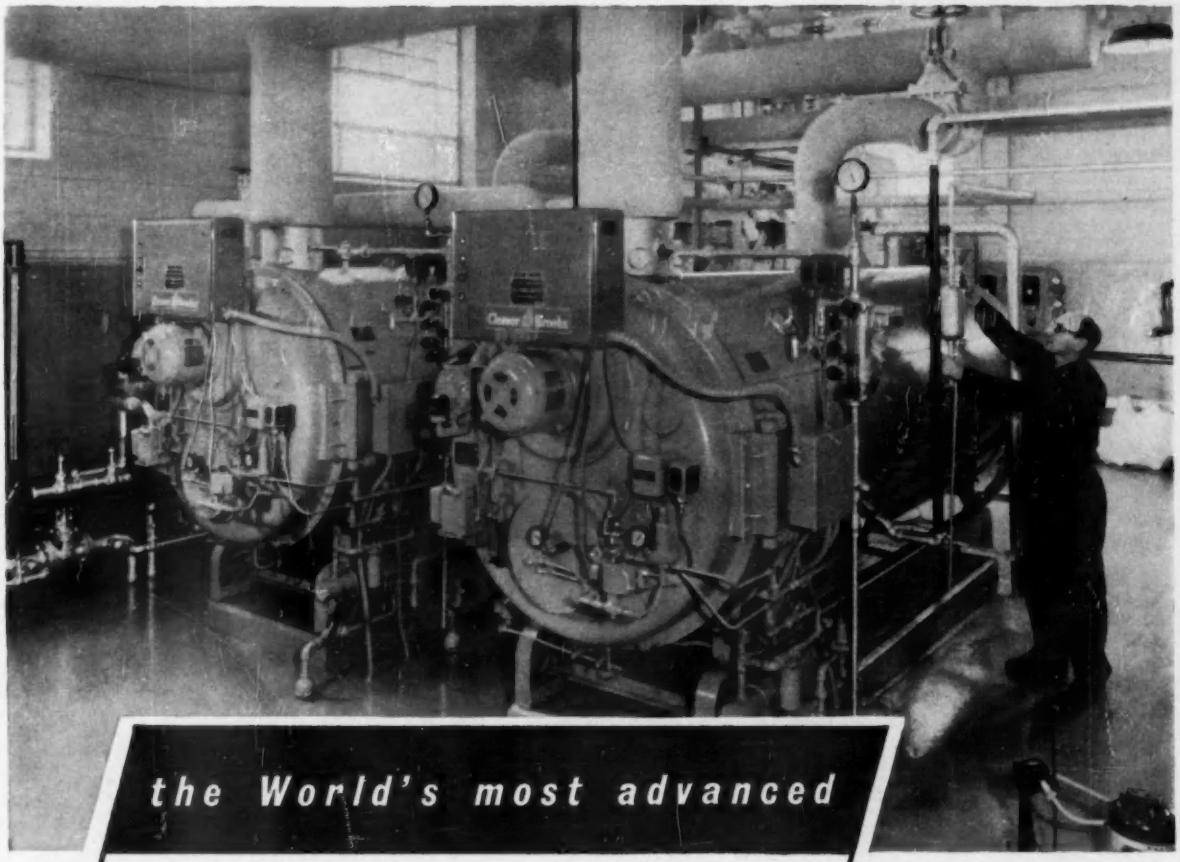

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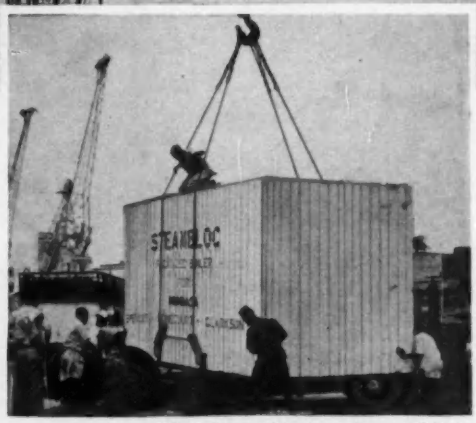


*Off loading at Mombasa for an Oil Refinery.*

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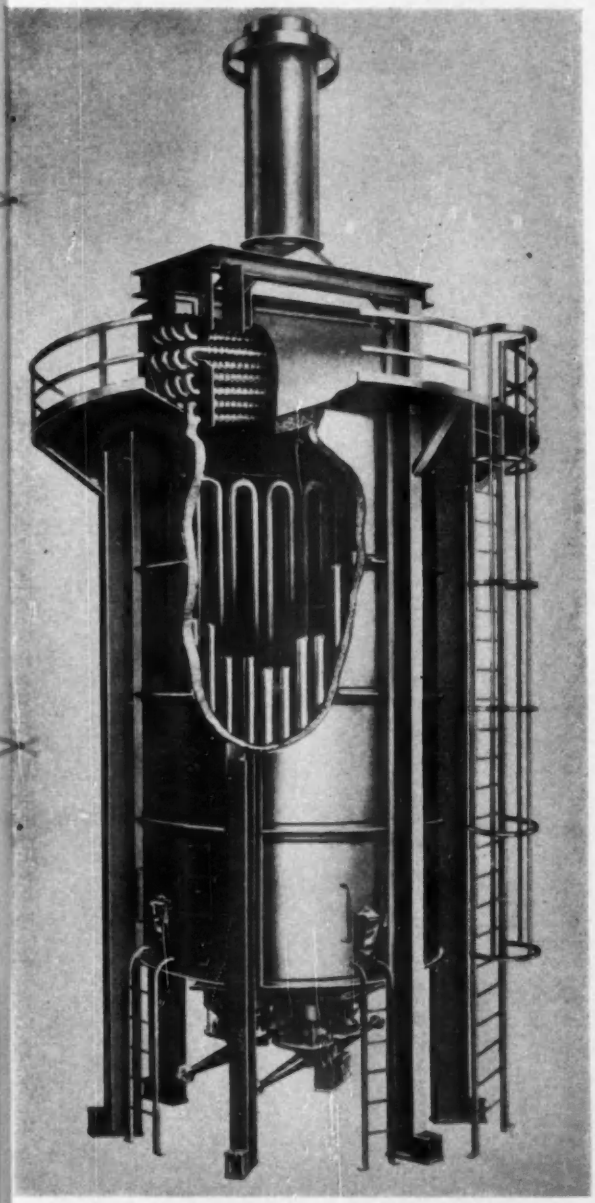

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***is now available direct to British Industry from***

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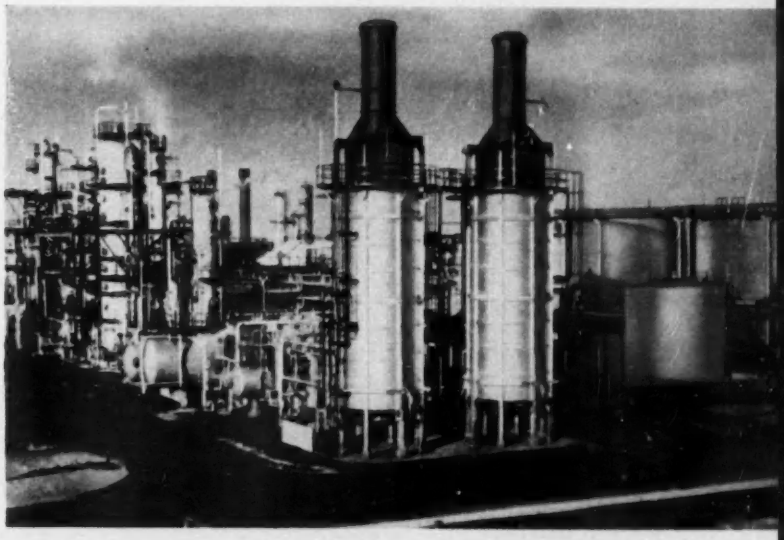

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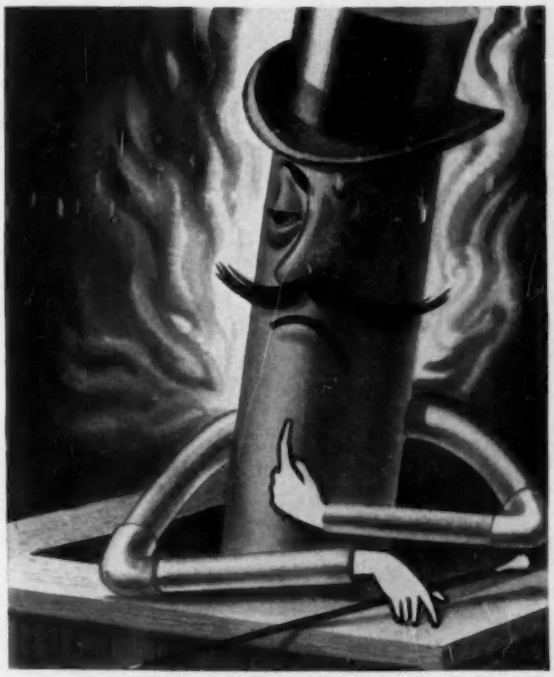

"I am a four-inch bore pipe. I work in a factory. It is my job to carry steam at 450°F. from generator to the plant. But I was a waster, a fuel waster, a *very* fuellish waster indeed!

I used to work naked as the day I was drawn. Of course I wasted heat—and therefore fuel—but who cared? Then one day, a bright spark from Fibreglass told the Manager that I was wasting nearly one ton of coal a year through each foot of my length.

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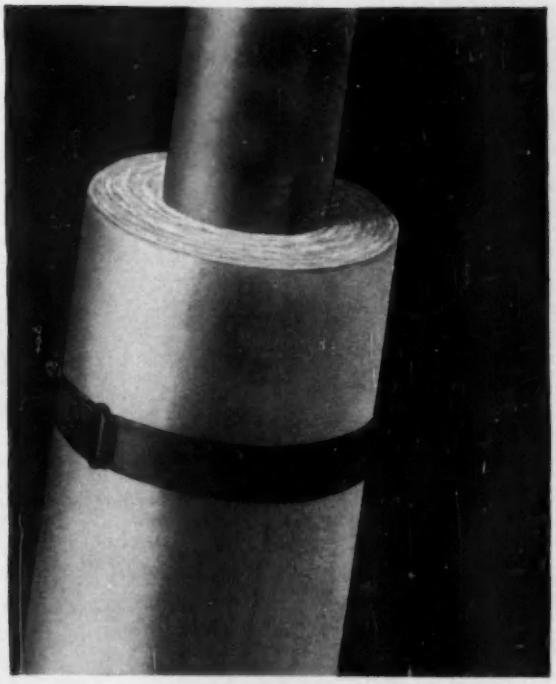

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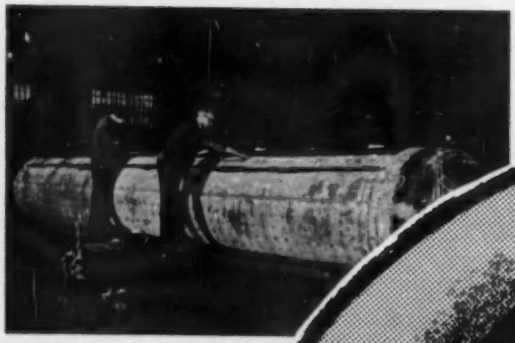

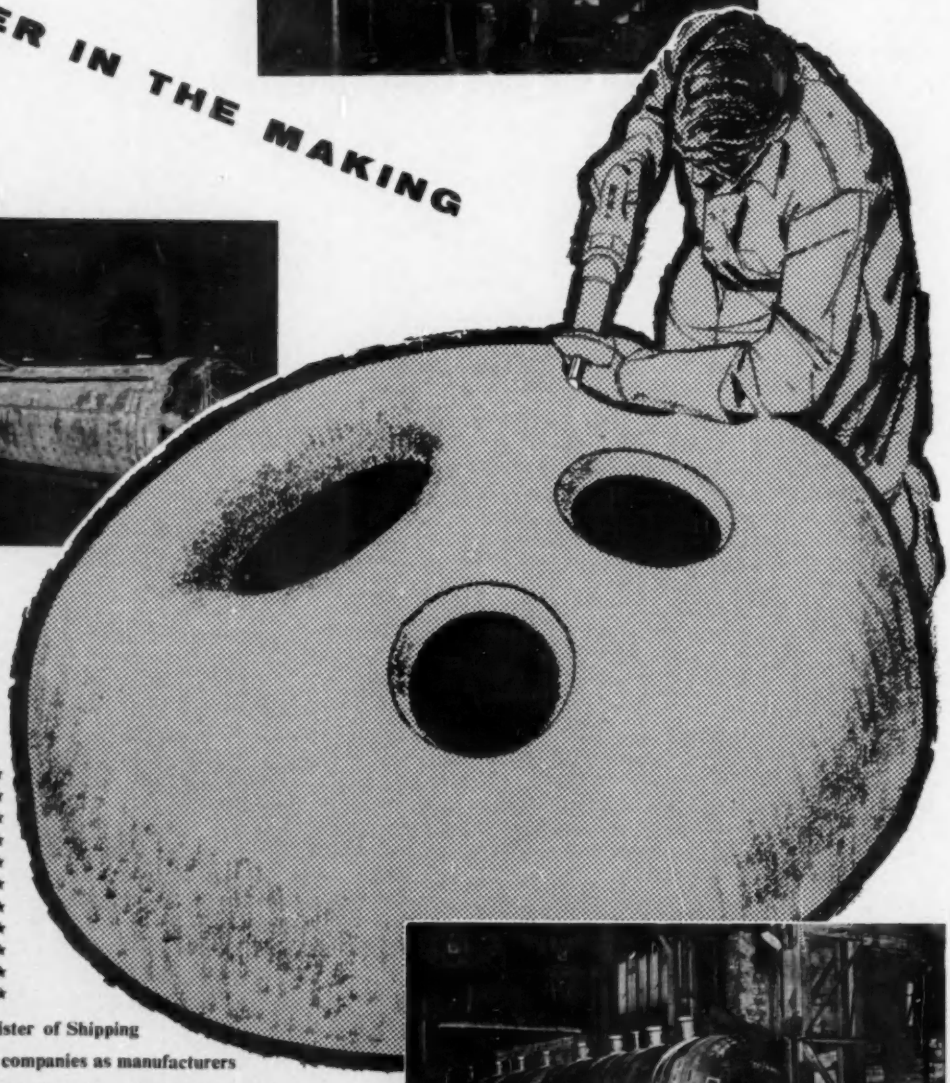

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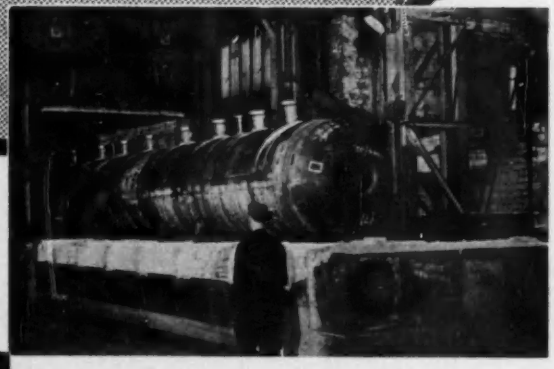

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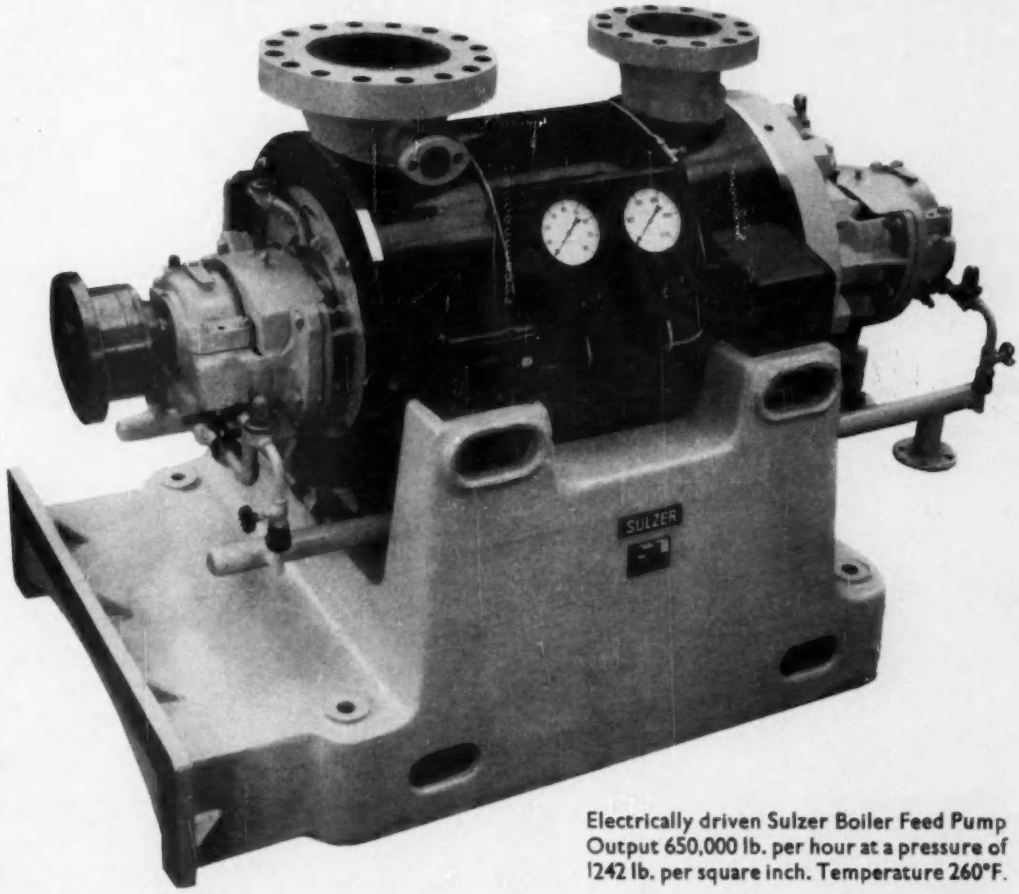


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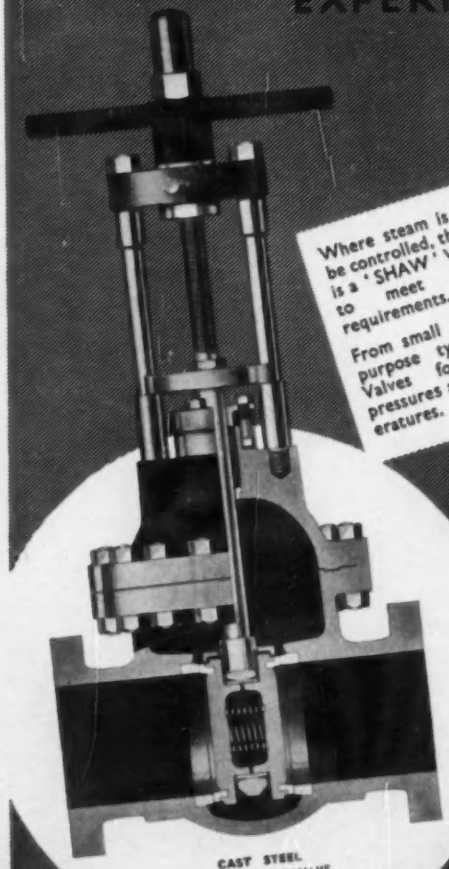

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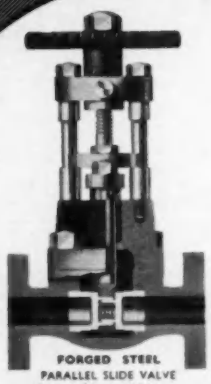
PARALLEL SLIDE VALVE
Sizes : 2" to 14" bore.



FORGED STEEL
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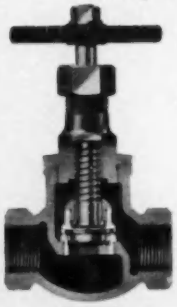
Sizes : ¾" to 1½" bore



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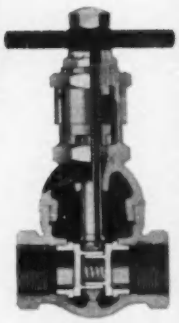

BRONZE
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Sizes . ½" to 2" bore.

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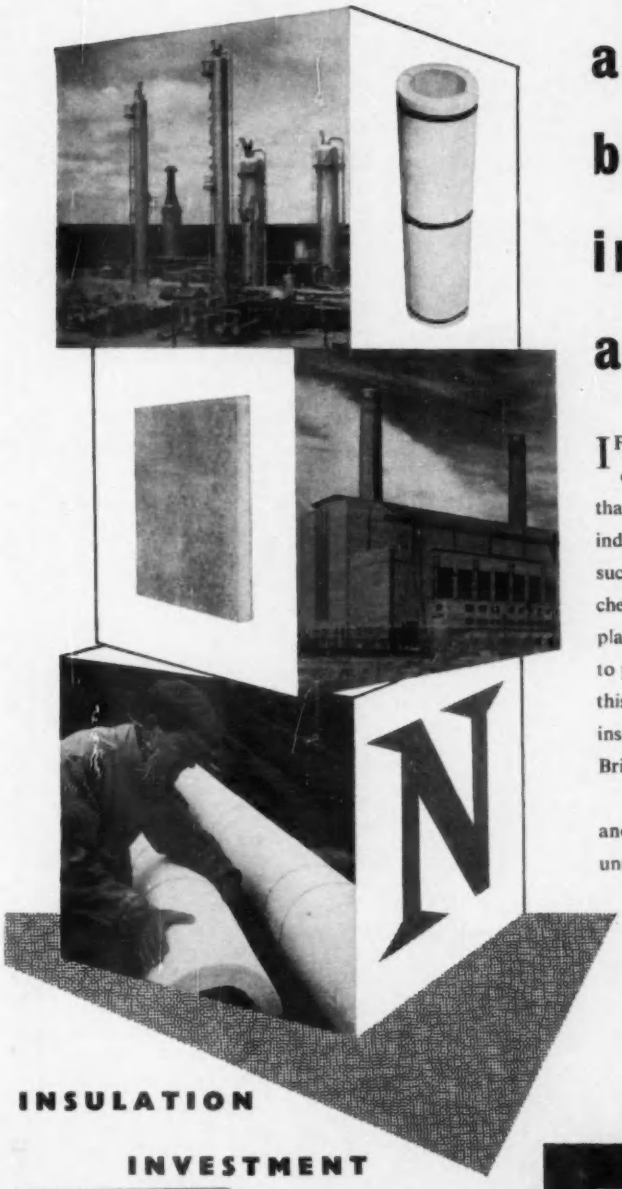
PARALLEL SLIDE VALVE
Sizes ½" to 2" bore

SHAW SON & GREENHALGH LTD.
HUDDERSFIELD ENGLAND




# a reputation built on industrial achievement

IF you look through a list of insulation contracts completed in recent years by Newalls you will see that they relate to many of the most important industrial enterprises undertaken since the war. In such a list will appear power stations, oil refineries, chemical works, cold stores, as well as many other plants where effective thermal insulation has been put to profitable use. Nor are our products confined to this country. For example, some 600 tons of thermal insulation material was supplied by Newalls to the British Petroleum Company's refinery at Aden.

Such a record can only have as a basis reliable and proved insulation materials combined with an unusual skill in the business of applying them.

**Newalls (Reg'd Brand) range of insulation materials covers all temperature requirements from minus 300° F up to over 2000° F. Comprehensive technical publications are available dealing with every aspect of thermal insulation and will be sent to you on request.**

**INSULATION INVESTMENT BEGINS WITH**

CHEMICAL & PETROLEUM ENGINEERING EXHIBITION
OLYMPIA 18-28 JUNE 1958

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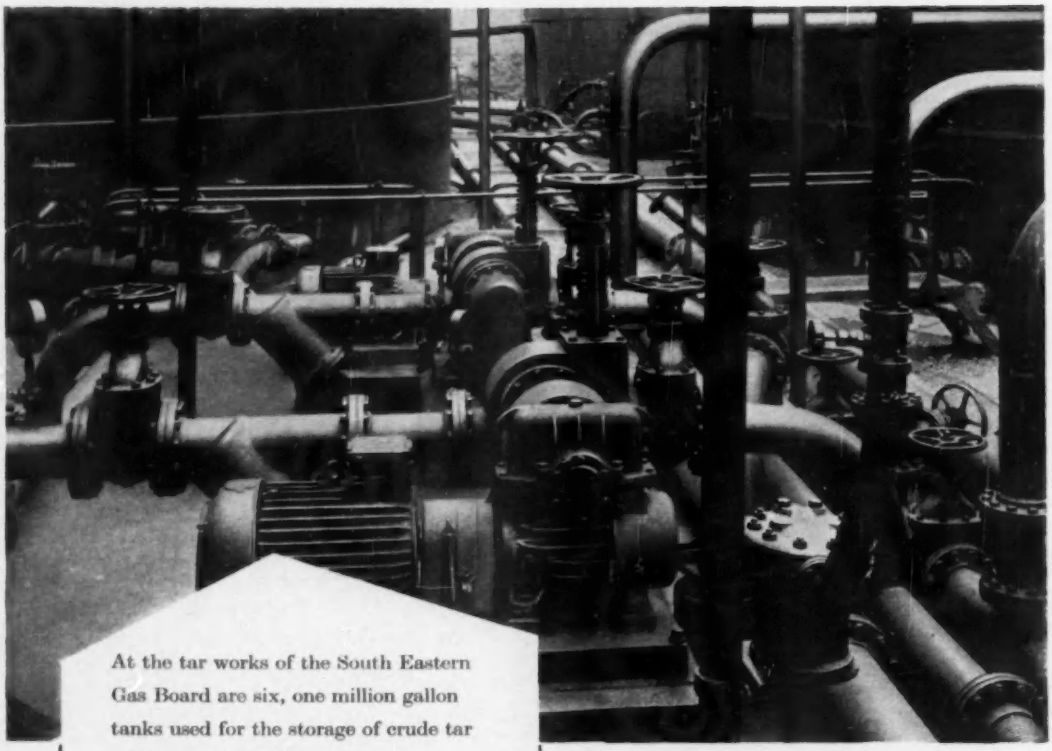
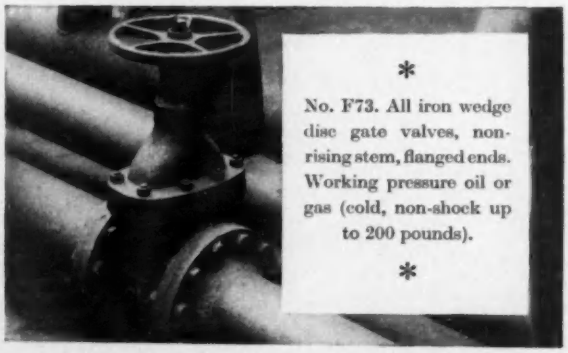
NEWALLS INSULATION COMPANY LTD. *Head Office:* WASHINGTON, CO. DURHAM
*A member of the* TURNER & NEWALL ORGANISATION
*Offices and Depots at* LONDON, GLASGOW, MANCHESTER, NEWCASTLE UPON TYNE, BIRMINGHAM, BELFAST, BRISTOL & CARDIFF. *Agents and Vendors in most markets abroad*



At the tar works of the South Eastern Gas Board are six, one million gallon tanks used for the storage of crude tar and its products. Here is shown a twin-pump unit coupled through Crane valves to 'the million gallon storage'. In fact all the materials which enter or leave these tanks pass through Crane valves—all iron wedge gate valves with non-rising stem. Yet another twin-pump unit in the same works handles refined tar through similar cast iron valves at about 180° F.; the same unit pumps Coal Tar Fuel to barges berthed at the Board's wharf on the Thames. Once again all valves function faultlessly—thanks to Crane!

# Once again, valves by Crane



*

No. F73. All iron wedge disc gate valves, non-rising stem, flanged ends. Working pressure oil or gas (cold, non-shock up to 200 pounds).

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**CRANE** VALVES OF BRONZE, CAST IRON & CAST STEEL

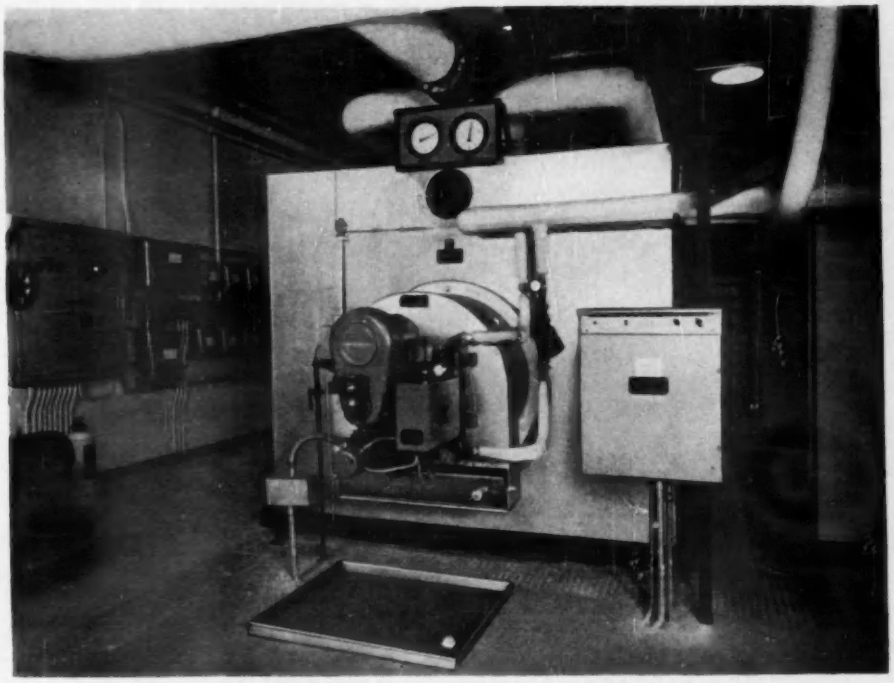
D28

CRANE LTD., 15-16 RED LION COURT, FLEET STREET, LONDON, E.C.4. Works: IPSWICH
*Branches: Birmingham, Brentford, Bristol, Glasgow, London, Manchester.*

# RADIANT WATER TUBE BOILERS

**STEAM OR HOT WATER** **STANDARD OR PACKAGED**

**Delivered assembled or in sections as required**



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FLATS
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UNIVERSITIES
AND
ALL
INDUSTRIAL
PURPOSES

ANY FUEL
ANY PRESSURE

5·1 million B.Th.U. per hr. 'B' Type Hot Water Boiler at the New Government Offices, Birmingham

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# The world's largest turbo-generator for Britain

**The Central Electricity Generating Board have ordered a PARSONS 550,000 kW turbo-generator to be installed in the projected Thorpe Marsh Power Station, Yorkshire. This machine, the largest generating set in the world, will consist of two lines arranged in line ahead, each line comprising four cylinders driving a 275,000 kW three phase generator.**

**Parsons have also received the order to construct the condensing and feed-heating plant for this machine.**

Steam conditions:

| | |
|---|---|
| Pressure: | 2,300 lb/in² |
| Temperature: | 1,050° F |
| Reheat: | 1,050° F |
| Exhaust Vac: | 28·7 in. Hg. |

All eight main cylinders will be of the double flow type with high pressure cylinder on "A" line taking the 550 MW steam flow. Exhaust steam from this cylinder will be reheated and passed to the first intermediate pressure cylinder on "B" line. Thereafter the steam divides equally between duplicate second intermediate pressure cylinders, one on each line, final expansion of the steam being through two low pressure cylinders on each line.
Each generator will operate at 18,000 volts ·85 P.F.: 50 cycles per second at 3,000 r.p.m. Stators will be hydrogen cooled with direct water cooled windings. The rotors will be direct cooled.

**PARSONS**

C. A. PARSONS & COMPANY LIMITED · HEATON WORKS · NEWCASTLE UPON TYNE 6

It is dangerous and wasteful to allow tubes in boilers, condensers, coolers and other heat-exchanging plant to become clogged by scale. Also it is quite unnecessary. Descaling regularly the "ATLAS" way is easy, convenient and far less expensive.

The "ATLAS" Descaling Service is operated only by our own experienced staff, and the work entails the minimum of interference with normal routine.

Scale is removed safely and completely by the use of "Atlas" Condenflu—the chemical cleanser that does not harm the metal. Let us quote for carrying out your next descaling job or, if you prefer, for supplies of "Atlas" Condenflu for your men to use.

*Descriptive booklet sent on request.*

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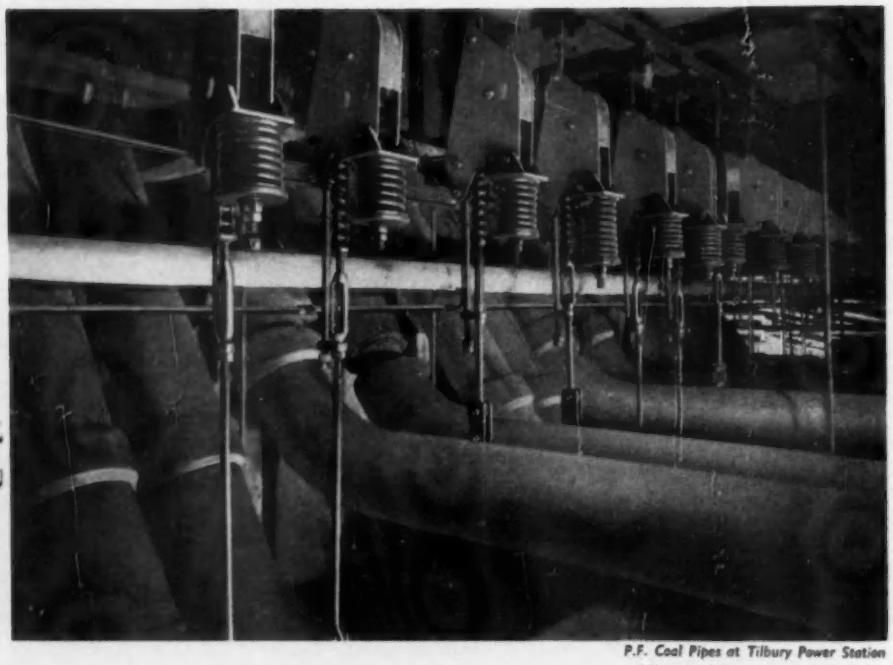
TAS/AS.103

E

# Constant TENSION



P.F. Coal Pipes at Tilbury Power Station
Photograph by courtesy of the C.E.A.

**For loads up to 4 tons and pipe movements up to 18".**

High-pressure steam piping is subject to wide variations in temperature, which produce considerable expansion and contraction. Unless the pipe supports can absorb and compensate for this movement, severe stresses are set up which may result in fracture. The " Con-Ten " Pipe Support is designed to cradle any type of piping with constant tension under all conditions, throughout the range of movement. " Con-Ten " is installed, with eminently satisfactory results, in power stations, oil refineries, chemical and industrial plants throughout the world.

# CON-TEN

*CONSTANT TENSION PIPE SUPPORT*

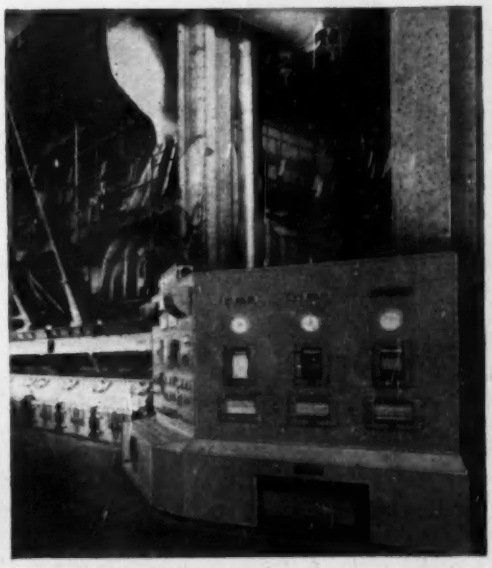
British Patent No. 474008. U.S.A. Patent No. 2129320.

**BRITISH INDUSTRIAL ENGINEERING COMPANY (STAFFS) LIMITED**

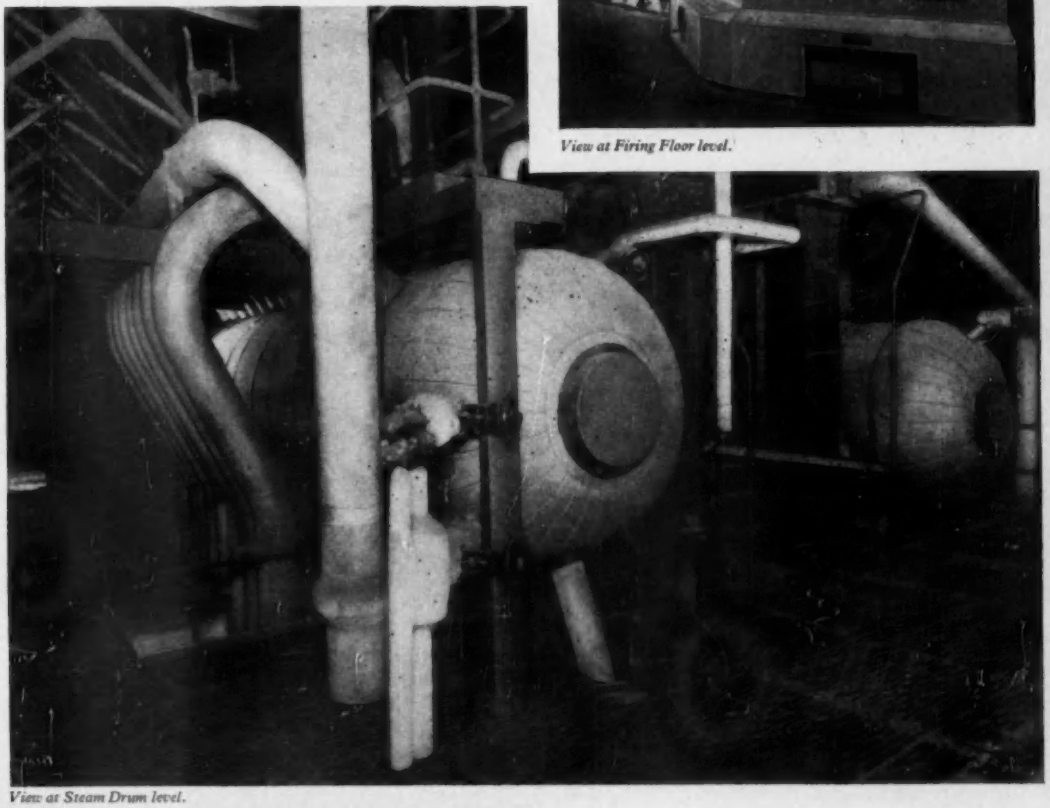
HAINGE ROAD, TIVIDALE, TIPTON, STAFFS TEL: TIPTON 1222

E

**Six stoker fired Yarrow Boilers recently installed at Dalmarnock Power Station for the South of Scotland Electricity Board.** Each boiler is designed for a maximum continuous evaporation of 200,000 lb. per hour at a pressure of 950 lb. per sq. in., and final steam temperature of 925°F.



*View at Firing Floor level.*

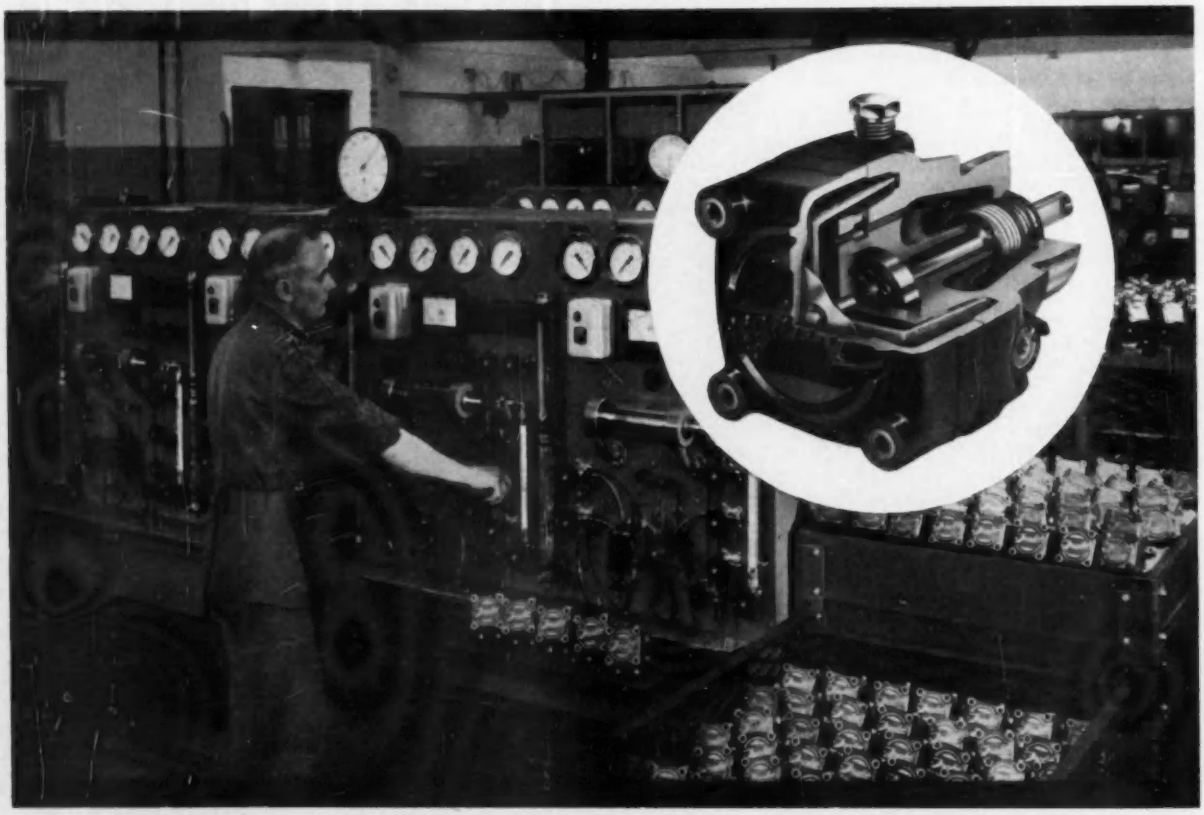


*View at Steam Drum level.*

**BOILERS BY YARROW**

YARROW & COMPANY LIMITED · SCOTSTOUN · GLASGOW W4

# The Danfoss oil pump, type HP with delayed opening, retains the oil until the blower reaches full pressure



This test-stand guarantees not only the pressure and the suction level as well as the amp consumption and the capacity, but also the cutting off ability of each single HP5 fuel unit leaving the Danfoss works.

This design ensures automatic ventilation of the boiler and instantaneous extinction of the flame. This has the effect that the boiler does not soot up and also that the nozzle does not carbonise.

**Primary advantages :**

a. a special regulating valve with delayed opening
b. flame is cut off in a flash
c. can be used for both 1 and 2 pipe systems with automatic change over

**Further it has following distinctive qualities :**

1. small dimensions
2. direction of the circulation can be easily changed
3. large suction capacity
4. noiseless running
5. can be fitted in any position
6. international shaft and hub dimensions

Danfoss

**AUTOMATIC CONTROLS AND EQUIPMENT**

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# Engineering and BOILER HOUSE REVIEW

THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

JUNE 1958

VOLUME 73. No. 6


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*The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable*


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# STEAM for Steel

We are exhibiting at the UNIVERSAL & INTERNATIONAL EXHIBITION BRUSSELS. April 17 — Oct. 15. **Brit. Ind. Pavilion Stand J** and the CHEMICAL & PETROLEUM EXHIBITION June 18 — 28. **National Hall, Ground Floor, Row P, Stand 8.**

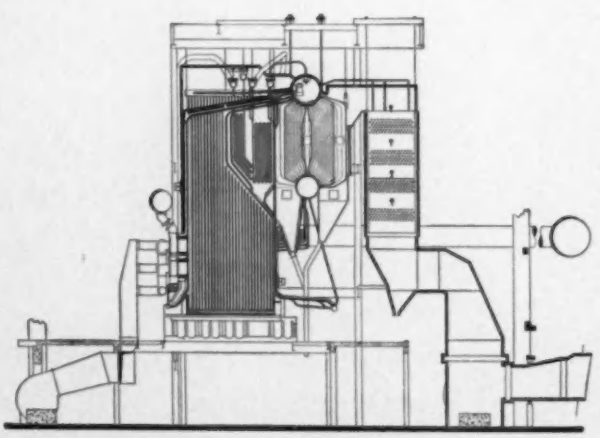
BABCOCK & WILCOX Ltd. are proud to have had an important part in the equipment of the new Colvilles £20,000,000 coke oven, blast furnace and steelmaking plant at Ravenscraig, Motherwell, Scotland.

They share a mutual interest in this great plant, as they are themselves considerable users of Colvilles steel for the manufacture of high-pressure boiler drums, and pressure vessels for the oil and chemical industries.

At the new Ravenscraig works, four Babcock Bi-drum boilers, each with an evaporation of 125,000 lb. steam/hr. M.C.R., at 425 lb./sq. in. and 820°F., supply high-pressure steam for electrical power generation and for the operation of turbo-blowers serving the blast furnaces. Provision is also made to supply steam for process purposes. The main fuel for the boilers is blast-furnace gas with a G.C.V. of approximately 98 B.Th.U/cu. ft., at a pressure of 10 in. w.g. Oil burners are also provided for auxiliary or alternative oil-firing and provision has been made for possible future stoker-firing to use coke-breeze from the works coke-ovens.

The contract placed with Babcock & Wilcox Ltd. by The General Electric Company Limited, main contractors for the electrical power plant, covered also the supply of much of the auxiliary plant including the oil-firing installation, oil piping, high-pressure pipework and valves in the boiler-house — including piping to turbo-alternators and turbo-blowers—Bailey automatic boiler control equipment, oil storage and service tanks and steel self-supporting chimneys—a good example of the comprehensive service offered by Babcock & Wilcox Ltd. to industrial steam-users.

# BABCOCK
## STEAM-RAISING PLANT



**Sectional arrangement of one of the 125,000 lb. / hr. Babcock Bi-drum boilers at the Ravenscraig works.**

**BABCOCK & WILCOX LTD., BABCOCK HOUSE, 209 EUSTON ROAD, LONDON, N.W.1**

Engineering and
BOILER HOUSE REVIEW

JUNE 1958

VOLUME 73 No. 6

## NUCLEAR EXPORT PROSPECTS

ELSEWHERE in this issue we make reference to the signing of a long-term agreement for collaboration between the Nuclear Power Plant Company Ltd. (N.P.P.C.) and A.G.I.P. Nucleare. We understand that the initial development in this agreement will be a contract to construct a single-reactor 200-MW nuclear power station at a site near Latina, some 50 miles south of Rome, and that the work is likely to be put in hand within the next month or so.

This is undoubtedly an achievement, particularly in view of the fact that while a great deal of enthusiasm and confidence have contributed so much to the rapid design and construction of nuclear power stations in this country, the British heavy nuclear industry has been subjected to a certain amount of criticism and expressions of disappointment recently on the lack of drive and development of means of obtaining export orders in this very promising field of power plant engineering.

At the same time, and although Britain's undoubted lead has not brought the rewards in export orders that were somewhat freely predicted about this time last year, too much criticism is unwarranted because the truth is, that the British consortium of manufacturers are, in fact, involved in some very important developments abroad, which will be revealed in due course.

The real significance of the recent Anglo-Italian agreement is not merely that the two consortia intend jointly to build a 200-MW nuclear power station, but that this, the first export nuclear power station in the world to be actually started, will be of British design and will incorporate much British equipment and materials. Surely this is justification of the faith and wise decisions taken at the right time by British scientists to concentrate on the design and development of the gas-cooled graphite-moderated reactor, and the natural uranium approach.

Furthermore, in the recently-signed agreement, another important factor is the declared intention of long-term collaboration, and the practical steps that are being taken to make that collaboration close and effective. As far as the Nuclear Power Plant Company is concerned the potential benefits from the agreement are self evident. For this consortium, like the others in Great Britain, must (as Sir Claude Gibb pointed out at a recent Press conference in London) make determined efforts to earn some return on the exceedingly heavy expenditure already incurred in nuclear engineering development work. This they can do either by constructing overseas complete nuclear power stations, or by manufacturing and supplying component parts, designs or " know-how " —bearing in mind that the market for the first alternative is limited—as the high capital cost of nuclear power stations is likely to provide a somewhat formidable obstacle to all but the most advanced countries. Many of the potential customers or countries that are contemplating building a nuclear power station, or have announced a nuclear power programme, are those which have some advanced industrial background, and possess strong engineering industries. These countries will obviously endeavour to acquire as early as possible the knowledge and experience that will enable them to design and build stations using nuclear fuels, just as today they build the more conventional plants.

In such circumstances, collaboration from the project stage has much to commend it, particularly in view of the fact that although the fuel and power problems of certain countries are no less urgent than our own, such countries are faced with a new technique, of which they have only theoretical knowledge; and on the strength of this have to make a decision as to which of the numerous available reactor systems would be the most efficient, and which would be best suited to the local conditions encountered in the country in question.

On technical grounds alone, this country is in a strong position to obtain some of the first contracts for overseas nuclear plants—because of the systems now available, only the British has been adequately tried out—even if some of the others may hold promise of higher efficiency. In addition, A.G.I.P. Nucleare have already chosen a station of British design after detailed study of American proposals; and if this choice is economically justified for this great Italian organisation, then there is the probability of other foreign organisations arriving at the same conclusion.

In any event, the present agreement between the N.P.P.C. and A.G.I.P. should not be looked upon as a single commercial pact. In the long run it should enable both the British and Italian concerns to make economical use of technological manpower and to benefit from both the knowledge and experience available. The agreement, in fact, may well serve as a pattern for Great Britain's contribution to the development of nuclear power in other interested countries.

# Points and Pointers

*MEASUREMENT OF SMOKE EMISSION FROM INDUSTRIAL BOILERS*

The first report has now been published of the work of the B.S.I. Committee which has been investigating the extent to which smoke from industrial boilers can be reduced by good practice. The report, covering medium capacity coal-fired water-tube boilers with travelling grates, is published as Part One of a new British Standard on *Measurements of smoke emission* (B.S. 2978). The next part of this standard to be issued will be concerned with shell boilers fired by various kinds of mechanical stokers. The report which has just been published will, we think, be of value to factory management and to local authorities in helping them to achieve a good standard of smoke control and compliance with the law under the terms of the Clean Air Act. To obtain the material on which this report is based, the B.S.I. Committee carried out tests on four water-tube boilers of modern design, known to be well operated, at a brewery, a paper mill, a chemical works and a colliery. Detailed records were kept of smoke emission from each of these plants over periods of from five to nine weeks. A résumé of results for each of the four boilers is given in the form of a table. There are notes on frequency of soot-blowing, on smoke emission during overload, rapidly-changing load, when lighting-up and bringing-up to load, and during mechanical breakdowns. The final conclusion is that " From the figures collected in this report, it would appear that average emissions of dark smoke in excess of 6 min. per shift per boiler can normally be avoided in water-tube boilers with travelling-grate stokers within the size range 30,000 lb./hr. to 50,000 lb./hr. A helpful section at the end of the report lists factors influencing smokeless combustion on travelling-grate stokers. Copies of B.S. 2978, Part One, may be obtained from the British Standards Institution, British Standards House, 2, Park Street, London, W.1. Price 5s.

*D.S.I.R. ANNUAL REPORT*

The Report of the Council for Scientific and Industrial Research for the year 1956-7 was published recently. It was the first report of the new executive council established under the D.S.I.R. Act 1956. The report, therefore, differs in some respects from its predecessors in that, instead of describing the department's activities in detail, it reviews the main problems with which the Council is concerned and the way in which they are being tackled. The report opens with a review of the great changes which have occurred in industrial and scientific research since the department was set up 42 years ago. It goes on to discuss the effect of these changes on the fundamental tasks of the department. Consideration is given, for example, to the part the D.S.I.R. should take in the conduct of pure research. The executive council says that the universities are, and will continue to be, the main centres of pure research, though a proportion of pure research, it is added, should be carried out wherever applied research is done on any scale. The report records the Council's belief that its expenditure on this activity must rise considerably ; in 1956-7 there were 115 grants for special research projects in science and technology, totalling £836,000 in value, compared with 47 grants totalling £400,000 in the previous year. Another matter considered in the report is the part that D.S.I.R. stations should play in research of direct application to industry. The scope of this work is at present being reviewed. Meanwhile, the Council says, there is a large and growing field of activity in which the Government has a direct interest and a special responsibility, and in which, therefore, the research work required is appropriate to a national research establishment. But in order to undertake new responsibilities, it is necessary to shed some of the existing load. As part of the Council's review mentioned above *ad hoc* committees have been set up to examine the work and functions of the National Physical Laboratory, the Chemical Research Laboratory and the Mechanical Engineering Research Laboratory. Finally, the Council expresses doubt of the adequacy of the resources for all that it is charged to do. The report points out that in those industries that do not benefit directly from research done primarily for defence purposes, the value of production approaches £10,000 million a year ; by contrast, the department is spending less than £10 million a year for all its activities.

*FINANCING OF ADVANCED SANDWICH COURSES*

Since the White Paper on Technical Education was published in February, 1956, the number of advanced sandwich courses, under which students spend part of the year in a technical college and part in industry, has increased from 100 to over 200, and the number of students taking them from 2,000-3,000 to 5,000-6,000. The objective is to raise the number of students to 15,000-20,000, and so contribute to the building up of the supply of technologists which the country needs. With a view to stimulating the spread of these courses, particularly among medium-sized and small firms, the Ministry of Education and the Federation of British Industries have been reviewing the arrangements for giving financial assistance to students who wish to take them. The Federation of British Industries, in a policy statement issued recently to all members, states its belief that industry, by enabling selected employees to pursue advanced sandwich courses, in addition to supporting day release schemes, acts in its own as well as in the nation's interest. The Federation recommends to its members that firms which already pay their students' fees and salaries should continue to do so, and expresses the hope that firms sending students on advanced sandwich courses in the future will follow this example, since it stimulates the student's

sense of loyalty to the firm and strengthens the firm's ties with the college. Such payments are treated as normal business expenses for tax purposes. The Ministry and the Federation recognise, however, that there are and will continue to be firms who do not feel able to meet the whole cost of such training. There will, therefore, be a continuing number of such students who will look to local education authorities for aid. In a memorandum also issued recently Mr. Geoffrey Lloyd, the Minister of Education, recommends local education authorities to give sympathetic consideration to such applications.

*BRITISH OIL BURNER MANUFACTURERS' ASSOCIATION*

The British Oil Burner Manufacturers' Association celebrated its Silver Jubilee Luncheon at The Trocadero Restaurant, Piccadilly, W.1 on Wednesday, May 7th. A record number of members and their guests attended the function, at which the principal guest was the Paymaster General, the Rt. Hon. Reginald Maudling, M.P. Mr. Maudling replied to the toast of "The Guests" proposed by Mr. W. A. Hubbard, President of the Association. Once again, there were many representatives from the oil industry among the guests including Mr. Lester N. Horne (Charringtons), Mr. R. J. Pinder (Esso Petroleum Co. Ltd.), Mr. J. R. V. Cooper [Petrofina (Great Britain) Ltd., Mr. C. K. Stringer (Power Petroleum Co. Ltd.), Mr. H. Cunliffe (Shell-Mex & B.P. Ltd.) and Mr. R. C. Clegg (Stevinson Hardy Co. Ltd.). Mr. C. K. S. Benham, B.A.(Cantab.), M.I.H.V.E., president of the Institution of Heating and Ventilating Engineers, was also present. At the annual meeting which proceeded the luncheon, Mr. W. A. Hubbard (Hubbard Combustion Ltd.) was elected president in succession to Mr. J. R. C. Boyce (British Oil Burners Ltd.) who has been president for four years. This is Mr. Hubbard's second term of office as he was president in the years 1938/44. Prior to being president, he was honorary secretary in the years 1933/38. Mr. J. D. Fitzgerald (Combustions Ltd.) and Mr. W. C. J. Mollison (Todd Oil Burners Ltd.) were elected vice-presidents, and Mr. R. H. G. Sutton [Urquhart's (1926) Ltd.] was again elected honorary secretary.

*INTERNATIONAL STANDARDS CONFERENCE*

The 1958 Assembly of the International Organisation for Standardisation—ISO—will be opened at Harrogate on June 9th by its president, Sir Roger Duncalfe. It will be the first occasion on which this triennial conference has been held in Britain, and a record attendance of some 1,000 delegates is expected. Visitors are coming from every one of ISO's 40 member countries—from the United States and Russia, the countries of east and west Europe, the Commonwealth lands, the Far East and South America. The delegates comprise industrial leaders, engineers, scientists and other specialists. The conference will last from June 9th to 21st. Headquarters will be at the Royal Hall, Harrogate, and arrangements are in the hands of the British Standards Institution, 70 of whose staff will be transferred to Harrogate for the duration of the conference. Comprehensive services for the reception and information of delegates and for document-reproduction are being laid on by B.S.I. A bulletin for delegates will be published daily in English and French and a team of interpreters will be on duty to help conduct business sessions in ISO's three official languages: English, French and Russian. The very full business programme will include visits by delegates to factories and other places of industrial interest in the area. There will also be a Government reception for the visitors and a banquet which will be attended by many leaders of British industry who have a special interest in standards work. ISO seeks to help world trade by smoothing out differences in the industrial standards of its 40 member countries. Industrial standards—which say how materials and products should be made and measured, tested or described—are increasingly used to stimulate productivity; it has, therefore, become of special importance in export trade that the standards of one country should not be in conflict with those of its customers or suppliers in another country. The work of ISO in evolving international standards is carried out by over 80 specialised technical committees whose interests range from automobiles and acoustics to screw threads and sieves. The newest of these committees—that dealing with nuclear energy—is seeking to evolve world standards for the safe and efficient design and operation of nuclear reactors and for the protection of workers from the danger of radiation; another objective is to draft a glossary of nuclear terms in ISO's three languages: English, French and Russian. Other items and processes which will be reviewed by standards experts at Harrogate include iron and steel, copper and light metals; solid fuels and fuel using equipment, various types of boilers; machine tools, and other industrial plant.

*INSTITUTE OF FUEL*

The annual luncheon of the Institute of Fuel was held on Thursday, April 24th, at the Connaught Rooms, Great Queen Street, London, W.C.2, and was attended by nearly 800 members and guests. In the course of a speech made in welcoming the guests, the president, Mr. H. McNeil, took the opportunity of paying tribute to the work accomplished by the late Dr. G. E. Foxwell, C.B.E., in fostering education in fuel technology, and added that it was appropriate that the newly-created Foxwell Memorial Fund should be devoted mainly to education purposes. A comparatively small proportion of the amount subscribed will provide a memorial tablet at the Institute headquarters and the bulk of the money will be invested to endow an exhibition, scholarship or fellowship, to be known by Dr. Foxwell's name. The president also presented the first Bone-Wheeler medal and prize to Mr. A. M. Freedman (who is now on the staff of The British Coal Utilisation Research Association) for his paper "Experience with the Humidification of Combustion Air to Prevent Boiler Fouling." Mr. McNeil also presented Lord McGowan with a past-president's badge. Other remarks made by Mr. McNeil concerned the growth of the Institute, the formation of a group in the Argentine, the growth in strength of the Australian Section, and the formation of a South-East London section. Mr. W. Lionel Fraser, C.M.G., replied to the toast of "The Guests" and made the subject of his remarks the commercial activities of the City, including those of banks, insurance, shipping and commodity markets. The presentation of the medal will annually be accompanied by a prize of £50, generously given by the Board of The National Industrial Fuel Efficiency Service Ltd.

# Hams Hall "C" Power Station

HAMS HALL "C" power station, operated by the Midlands and East Midlands Region of the Central Electricity Generating Board, was formally opened on May 9th by the Rt. Hon. Lord Citrine, P.C., K.B.E., LL.D., who was chairman of the Central Electricity Authority from April, 1948, to December, 1957, and is now a part-time member of the Electricity Council.

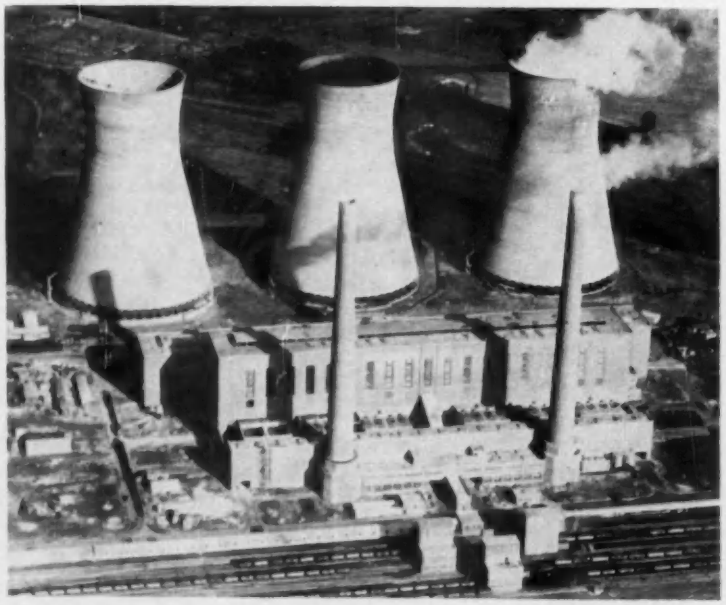
The site of the new station forms part of the Hams Hall estate, and is situated nine miles north-east of the City of Birmingham. In 1919, the area, known then as Hams Park, was purchased by the City for the development of its Electricity Supply Department, and the first station, Hams Hall "A," with a capacity of 249-MW, was completed in 1938/39. The construction of Hams Hall "B" was commenced immediately, and with work proceeding during the war, the final extension, bringing the total output to 321-MW, was completed in 1949. The new "C" station has a capacity of 360-MW, this making the installed generating capacity of the three stations 930-MW. The northern boundary of the new station site is formed by the main Birmingham to Derby railway line, while a loop from this line—which has a connection into Leicestershire—forms the southern boundary; the whole of the sidings serving the three stations being connected to this loop. The river Tame enters the site at the south-east extremity, and is immediately joined by the effluent outfall from the Minworth sewage works of the Tame and Rea Drainage Board. The river flows through the southern half of the site, and after joining the River Blythe loops to the north, forming the eastern boundary. The greater part of the circulating-water make-up for the "A" station is taken from the sewage outfall, while the river provides the corresponding supply for the "B" and "C" stations.

The site of the Hams Hall "C" station is generally level over a bed of gravel and sand at varying depths. Below this, is a soft clay which increases in strength until Keuper marl is reached. Individual concrete foundations were taken down to the marl level. Work on the site commenced during September, 1952, and as at the time the station was designed there was a shortage of structural steel, the framework of the turbine room and switchgear bay was constructed in ferro-concrete, while only 6,726 tons of structural steel was used for the boiler house, bunker and control panel bays. The whole of the cladding for the station is of brick. L. G. Mouchel & Partners Ltd. were the civil consulting engineers; Sir Robert McAlpine & Sons Ltd. were the main contractors for the site levelling and foundations; Braithwaite & Co. Ltd. for the structural steelwork; and Staverton Builders Ltd. for the superstructures. J. L. Keir & Co. Ltd. were responsible for the ferro-concrete work in connection with the three cooling towers, and the two chimneys were constructed by D. Theaker & Co. Ltd.

**Coal-handling plant**

The coal-handling plant supplied by Mitchell Engineering Ltd. is designed for a total capacity of 600 tons/hr. direct from tipplers to bunkers. Three wagon-tipplers of the single-cam, side-discharge type are arranged about the centre-line of the station each on a separate railway track. Coal from one of these discharges direct on to either of two 42-in. belt-conveyors passing directly to the bunker bay, where they discharge on to shuttle-belts running over the boiler bunkers. The two remaining units discharge on to 30-in. separate feeder belts, which, in turn, discharge into breeches chutes located over the main 42-in. conveyors.

The station can also be supplied with coal from a 200,000-ton capacity storage area. Two further wagon-tipplers are provided for coaling to store, one feeding either a 36-in. inclined belt conveyor which forms an initial pile on the coal store, or a 42-in. conveyor back to the station, where it discharges on to either of the two main 42-in. conveyors to the bunkers. The second tippler discharges on to a further 42-in. reversible belt conveyor, which in one direction can form a second initial pile on the storage area, and in the other can feed back to the station. These conveyors run in a covered gantry some 1,085-ft. in length. Road-borne coal, or coal from store can be tipped by mobile plant into either of two reclaiming hoppers located over these conveyors.



*An aerial view of the new Hams Hall "C" station taken from the south.*

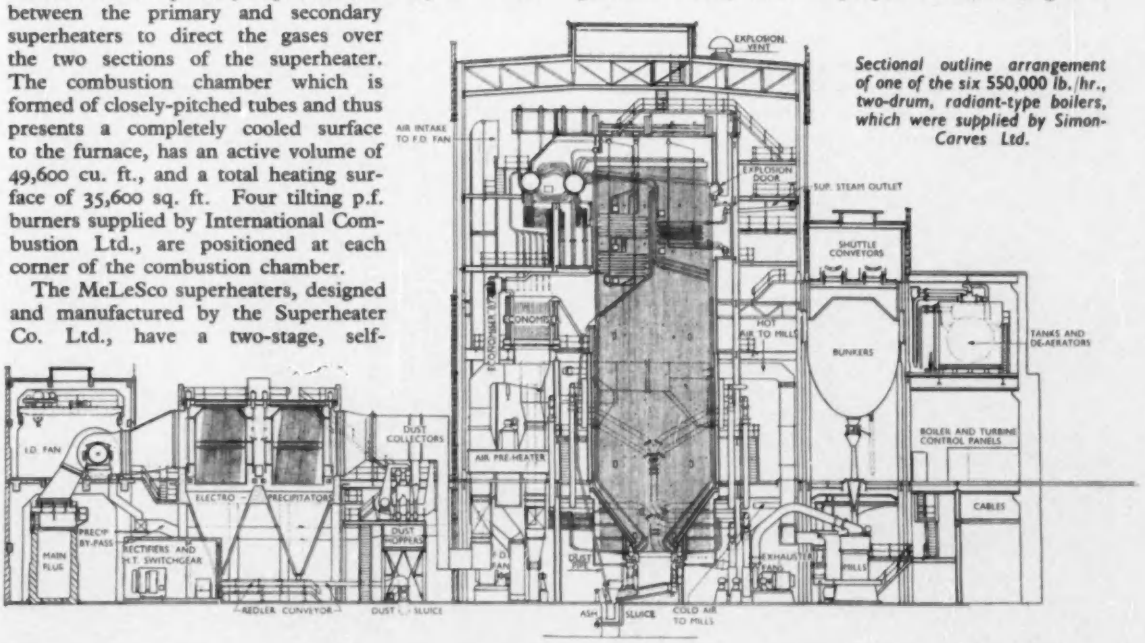
Size 26, Vulcan-Sinclair fluid couplings of the traction-type supplied by Fluidrive Engineering Co. Ltd., are incorporated in the drive-heads of two of the Mitchell conveyors, while the necessary motors were supplied by the English Electric Co. Ltd. The dust-extraction plant installed in association with the coal-handing equipment was supplied by the Sturtevant Engineering Co. Ltd.

**Boiler plant**

The boiler plant was designed and erected by Simon-Carves Ltd., and comprises six units of the two-drum, high-head, natural-circulation, radiant-heat type, fired by pulverised-fuel ; each unit being designed for a m.c.r. of 550,000 lb./hr. at 950 lb./sq. in. and 925 deg. F., with a feedwater temperature of 385 deg. F. The two boiler drums are of solid forged construction and are carried by slings from the steel supporting structure. The boiler tubes are carried by spring supports. A proportion of the front wall tubes form the roof of the combustion chamber zone, and the remainder form a screen below the secondary superheater section and then pass between the secondary and primary sections to the collector drum. Similarly, a proportion of the rear-wall tubes form a screen below the primary superheater and then pass between the primary and secondary sections to the collector drum. Baffles are carried on the rear wall tubes below the primary superheater and by the tubes between the primary and secondary superheaters to direct the gases over the two sections of the superheater. The combustion chamber which is formed of closely-pitched tubes and thus presents a completely cooled surface to the furnace, has an active volume of 49,600 cu. ft., and a total heating surface of 35,600 sq. ft. Four tilting p.f. burners supplied by International Combustion Ltd., are positioned at each corner of the combustion chamber.

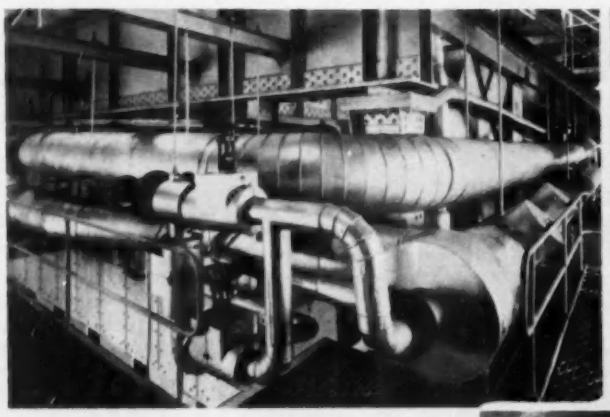
The MeLeSco superheaters, designed and manufactured by the Superheater Co. Ltd., have a two-stage, self-draining primary section with a gross heating surface of 5,574 sq. ft. MeLeSco spray-desuperheaters are installed in the cross-over arrangement of piping between the primary outlet header and the top intermediate header. Automatic steam temperature control is by means of the tilting p.f. burners. The spray desuperheaters are for manual operation when changes in fuel, etc., bring the burners down to their lower limit, or for biasing control when operating conditions produce undue out-of-balance in the temperature of steam leaving the left and right-hand sides of the superheater. During the design stages considerable thought was given to the problem of two-shift operation, and it is noteworthy that on this plant a comprehensive installation of MeLeSco supervisory thermocouples is incorporated in all boilers, to provide a continuous record of steam temperatures leaving selected superheater elements and superheater metal temperatures on primary and secondary sections at points within the gas path.

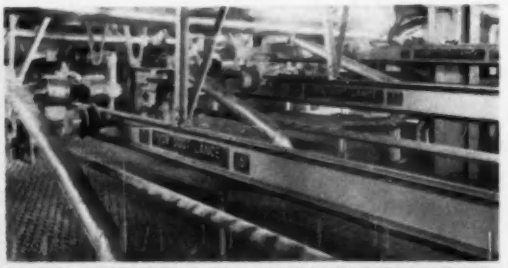
The oil lighting-up equipment for each boiler comprises six standard type FF1/80 initiators manufactured by Fuel Firing Ltd., and designed for a throughput of 800 lb./hr. of 960 sec. Redwood No. 1 fuel oil. They are all located in the boiler front wall—three at each side arranged on the centre line between the p.f. burners, in which position they perform a dual function of raising boiler steam pressure and, in fact, carrying the steam load for the turbine before pulverised coal is admitted for ignition by the same flames. A third purpose of the initiators is to stabilise automatically the p.f. flame at low load conditions by means of an electronic system introduced and manufactured by Fuel Firing Ltd. In addition to the six initiators in the front wall of No. 1 boiler there are three units of a similar type positioned at the top of the furnace immediately below the first bank of generator tubes, for the purpose of increasing and controlling the degree of superheat with a view to matching temperature conditions at the turbine when starting up on two-shift operation.

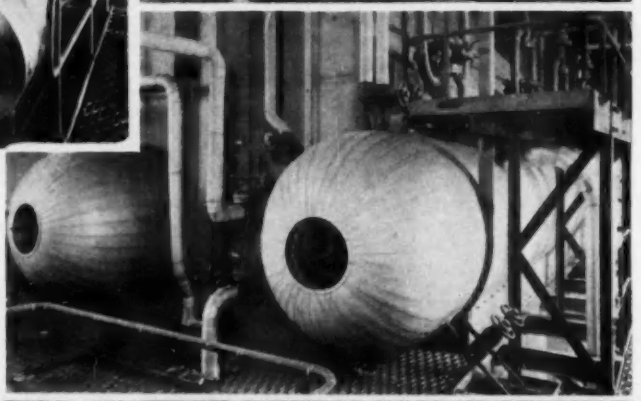



*Sectional outline arrangement of one of the six 550,000 lb./hr., two-drum, radiant-type boilers, which were supplied by Simon-Carves Ltd.*

The boiler bunker system is in the form of a single structure of catenary cross-section, which is divided into six compartments, each of 1,000 tons capacity, from which coal is fed through twin-feed chutes to type-LM 16 " Lopulco " pulverising mills manufactured by International Combustion Ltd. Each boiler is served by four







*(Above, left). Desuperheater pipework, supplied by Stewarts & Lloyds Ltd., with a design pressure of 1,130 lb./sq. in. at 850 deg. F.*

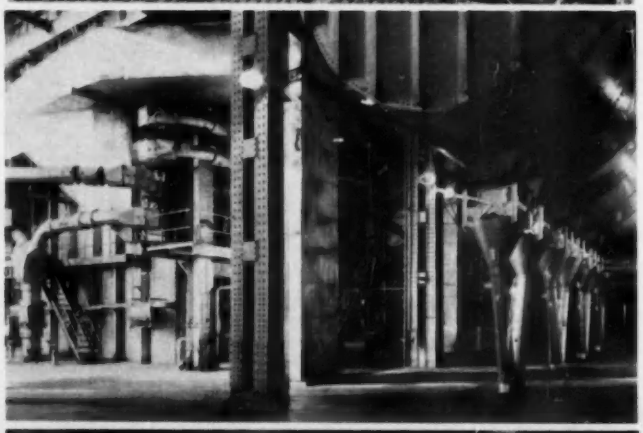
*(Above, right). Three of the lance-type soot-blowers supplied by The Ivor Power Specialty Co. Ltd. Eighteen of these units are provided for each boiler.*

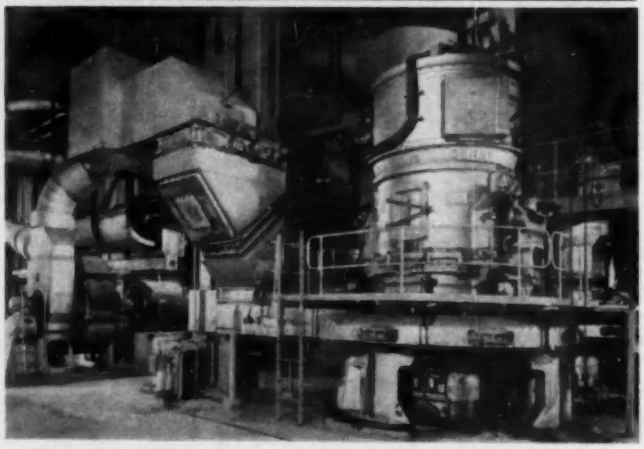
*(Right). View at drum level of one of the six Simon-Carves, 550,000 lb./hr. boilers.*

pulverising mills, designed for a capacity of 13.65 tons/hr., when dealing with coal having a moisture content of 18 per cent., and driven through reduction-gearing by a 185 h.p., totally-enclosed, fan-cooled, "Trislot" high-torque squirrel-cage induction motor, running at 1,480 r.p.m., manufactured by Laurence, Scott & Electromotors Ltd. The table and plough-type feeder associated with each mill is driven by a Laurence, Scott 2/0.28 h.p. N-S variable-speed a.c. motor, running at 2,200/314 r.p.m. James Howden & Co. Ltd. supplied four exhauster fans for each mill, designed for a capacity of 22,000 cu. ft./min. at a static pressure of 31-in. w.g., and a temperature of 155 deg. F. These are driven by Laurence, Scott 250/7 h.p. N-S variable-speed a.c. motors, running at 1,470/960 r.p.m.

Two steaming-type economisers supplied by Senior Economisers Ltd. are installed; arranged in parallel, they have a total heating surface of 23,296 sq. ft., and are designed to reduce the temperature of the gases from 940 to 631 deg. F. on the maximum boiler rating, and to raise the temperature of the feedwater from 385 to 473 deg. F. Each economiser is arranged 16 tubes wide, by 14 high and 13-ft. long over surface.

Two Howden-Ljungström rotary regenerative type air-preheaters, with individual heating surfaces of 77,800 sq. ft., and designed to reduce the flue gas temperature from 631 deg.



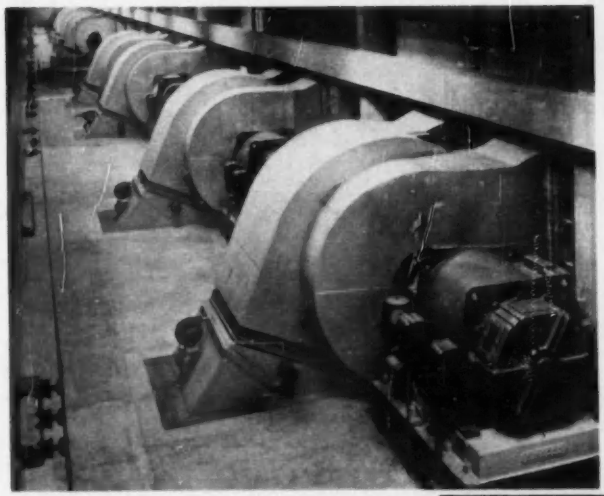


*(Above, right). View at firing-floor level showing the catenary cross-section bunker, and on the left the p.f. pipes, burner boxes and hot-air ducting.*

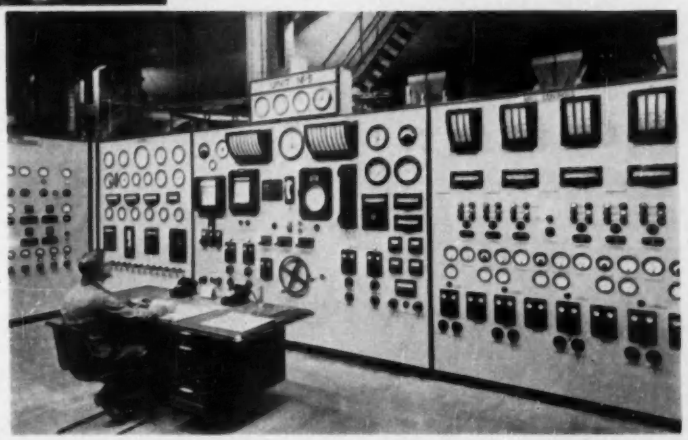
*(Right). Four International Combustion Ltd. type LM16 "Lopulco" pulversing mills each of 13.65 tons/hr. capacity are provided to serve each boiler.*

to 276 deg. F. whilst preheating the combustion air from 90 deg. F. to 546 deg. F. at the m.c.r., are provided for each boiler. The heating surface elements are arranged to give the most effective overall rate of heat transfer between air and gas and can be easily inspected or removed through top and bottom sector doors without disturbing either the gas or air ducts.

The draught equipment for each boiler comprises two 89,000 cu. ft./min. 76-in. dia. double-inlet, backward aerofoil bladed f.d. fans and two 155,000 cu. ft./min. 62½-in. dia. single-inlet backward aerofoil bladed, i.d. fans. All the fans were supplied by Davidson & Co. Ltd., and they are driven by Laurence, Scott & Electromotors Ltd., variable speed a.c. commutator motors—the i.d. fans by 435/8 h.p. motors at 970/243 r.p.m., and the f.d. fans by 191/7 h.p. motors at 1,050/325 r.p.m.



*(Above). Two Davidson & Co. Ltd. 155,000 cu. ft./min. i.d. fans are provided for each boiler. These are driven by motors supplied by Laurence, Scott & Electromotors Ltd.*



*(Right). The boiler/turbine control panel, supplied by Bailey Meters & Controls Ltd., for No. 5 unit.*

The sootblowing equipment, supplied by Ivor Power Specialty Co. Ltd., for each boiler comprises thirty units, all electrically-operated and controlled and selected from the sootblower control panel which is built into the main boiler control panel. Twelve " gun " type sootblowers are arranged to clear the furnace, and eighteen lance blowers, with an average withdrawal of 18-ft., are situated to clear the superheater banks and rear passes. They are all of the " valve-in-head " pattern, and the " gun " type units are fitted with a control unit which can be adjusted to give variation of the number of blows or variation of sequence pick-up for the succeeding sootblower. Steam is supplied to this equipment at 950 lb./sq. in. and 650 deg. F. Suitable blowing pressures are obtained by inserting an orifice plate before each sootblower valve. The pressures vary from 80 lb./sq. in. to 200 lb./sq. in. at the nozzle, according to the location of the sootblower unit in question.

Pulverised-fuel dust is removed from the boiler flue gases by two mechanical dust-collectors and two Simon-Carves horizontal twin-flow two-zone electrostatic-precipitators with chute-type receiving electrodes. These are arranged in two parallel circuits, each circuit consisting of one collector and one precipitator in series. High-tension d.c. is supplied to the precipitators by Simon-Carves-Ferranti totally-enclosed shock-proof static selenium/metal rectifiers. The combined guaranteed efficiency of collection is 98.6 per cent. at the m.c.r. Davidson & Co. Ltd. supplied the 126-cell S.F. dust-collectors, together with 41-in. double-inlet, class " D " dust-type booster fans each with a capacity of 23,800 cu. ft./min. These latter fans are driven by 48-h.p. 970-r.p.m. totally-enclosed, fan-cooled " Trislot " type motors, supplied by Laurence, Scott & Electromotors Ltd.

The mountings and valves for the boiler plant were for the most part supplied by Hopkinsons Ltd., and include torsion bar safety valves (including electrically-assisted units); high and low-water alarms; water-level indicators (including bi-colour units); combined stop and non-return valves; Hopkinson-Ferranti valves; electric valve controls; " Uniflow " valves; and safety valve silencers, etc.

Stewarts and Lloyds Ltd. were responsible for the supply and erection of the high-pressure steam piping and the feed pipework associated with all six turbo-alternator sets and the boilers, including the supply of the necessary h.p. valves and lagging. Piping of sizes up to 9-in. were supplied, and these involved the use of both alloy and mild steel materials, joints in general being of the company's welded type. As a separate contract Stewarts and Lloyds supplied and erected the major portion of the low-pressure station pipework in sizes up to 15-in., together with valves and lagging, and as sub-contractors supplied, and in some cases erected, much of the boiler and turbine integral pipework.

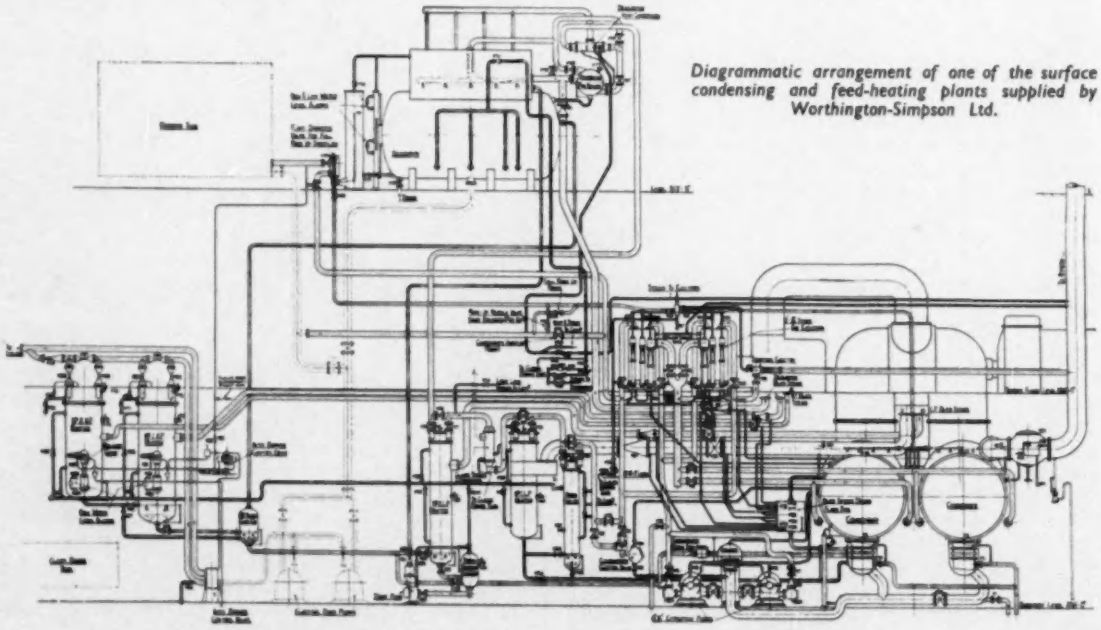
Insulation work on the boiler drums, downcomer tubes, steam and feed piping, oil tanks and internal draught plant, etc., was carried out by Wm. Kenyon & Sons (Thermal Insulations) Ltd., and comprises a galvanised sheet metal casing covering Rocksil insulation material which is supported by insulated or prong-type

distance rings, or Nelson studs. Pre-formed materials and the company's K3 hard-setting composition, suitably waterproofed, were used for the external work on the boiler flues and dust-collecting plant.

**Boiler control equipment**

The automatic boiler control equipment was supplied by Bailey Meters and Controls Ltd., and is of the air-operated type, designed to operate on a parallel series cycle, and to cover the automatic operation of the mill-feeders, exhausters, f.d. and i.d. fans, and coal-pulverising mill inlet pressure. The system permits operation under (a) manual control independently on any device incorporated in the system; (b) manual steam pressure control, while maintaining automatically combustion efficiency and furnace pressure; and (c) fully-automatic pressure and combustion control. Primarily the control signal initiates from the master pressure recorder/controller, which passes an air-pressure signal in the event of any deviation of steam pressure from the desired value, proportional to the amount of the deviation. The air-loading pressure from the master selector valve passes directly to the exhauster selector valves, the exhauster motors being varied in speed in accordance with changes in the loading pressure. Mill-feeder motors are controlled by the variation of the exhausters and of the differential across the respective mills. The output of the f.d. fans is obtained by speed variation through induction regulators and commutator motors, and in view of the size of the induction regulator an electro-pneumatic control is used, mounted on top of the induction regulator, and with a shaft connecting it to the rotor shaft of the regulator. The fan speed is initially set by the master controller, but is, if necessary, corrected by the steam flow/air flow meter, so that the desired steam flow/air flow ratio is maintained. The i.d. fans are also varied in speed by induction regulators, and are fitted with a similar controller to that on the f.d. induction regulators. The same loading-pressure signal as used for controlling the f.d. fans is passed to the i.d. fans, but should the resultant change in speed have the effect of varying the furnace draught from that previously required, then the furnace-draught indicator/controller will detect this and send out a corrective signal, by which the necessary readjustment is made. To each mill inlet damper is connected a control drive, which, with the selector valve in the "automatic" position, can be controlled directly from a diaphragm-operated mill suction-controller connected to the mill inlet, the diaphragm mechanism initiating a signal should the mill inlet pressure vary from the desired value. These latter controls operate independently of the master pressure controller, and the damper is positioned directly by proportional control.

Six sets of hydraulic boiler damper controls, supplied by Automotive Products Co. Ltd., provide power-hydraulic operation of 22 dampers per boiler, and incorporate manual-hydraulic stand-by control which comes automatically into use in case of power failure or other emergency. An unusual feature of the installation is the fact that the pump motor units are housed separately, together with their contactor starters, in small "power cabinets" instead of being installed on the floors of the main control cabinets. Two $1\frac{1}{2}$-in. × 6-in. stroke high-duty "Autoloc" cylinders are employed for f.d. fan discharge dampers, another pair for air-heater by-pass and two further pairs of similar cylinders for economiser by-pass and precipitator by-pass dampers, while four further units of the same size control dampers for the air inlets to the mills. Two $1\frac{1}{4}$-in. × 10-in. stroke cylinders actuate the i.d. fan outlet dampers, while four similar cylinders, coupled in pairs by cross-shafts, are employed for the grit arrestor inlet. Two cylinders of $1\frac{3}{4}$-in. × 10-in. stroke are used for the air-



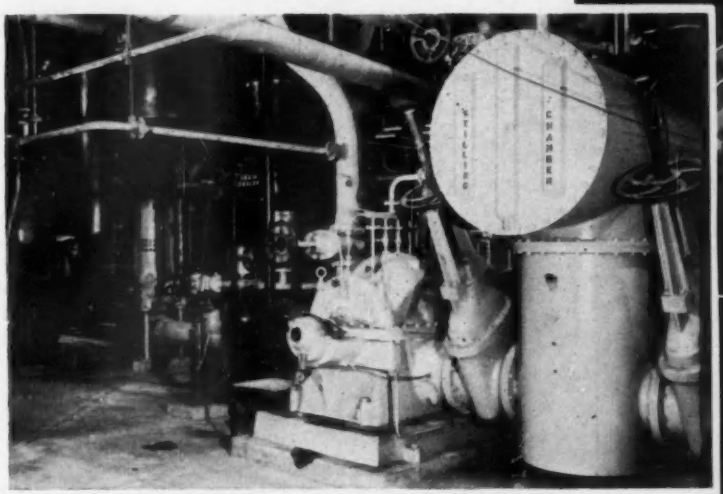
*Diagrammatic arrangement of one of the surface condensing and feed-heating plants supplied by Worthington-Simpson Ltd.*

heater air outlet and two more of the same type for the precipitator outlets. Regulating indication is provided in the case of the four air-heater dampers, the four controlling air to mills, and the two economiser by-pass dampers ; limit indication being employed for the remainder.

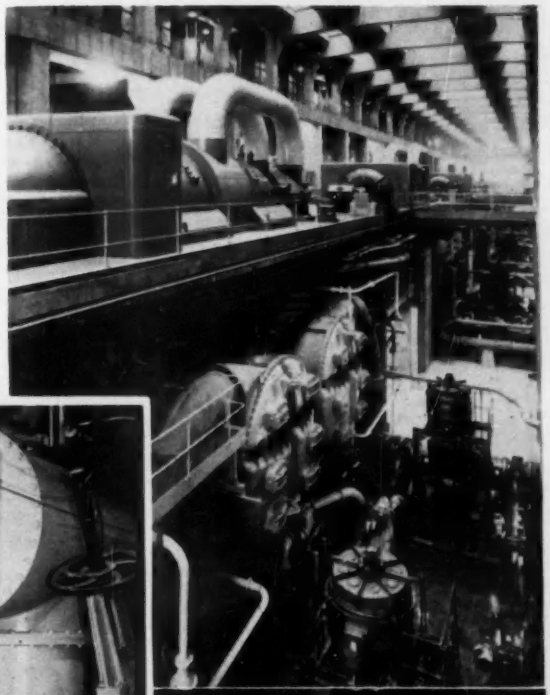
**Ash-handling plant**

The clinker and fly-ash handling plant supplied by Babcock & Wilcox Ltd. is designed to dispose of 300-tons of clinker and 700-tons of dust each day, and to transfer it to settling ponds situated to the north-east of the station. After drying, the residue is dug out and conveyed by road haulage to disused gravel pits. At the present time there are two settling ponds, and a third is being constructed to cope with the additional load. The ash is collected in dry hoppers under each boiler, and discharged at intervals into an ash sluiceway by high-pressure water jets. Jets are also arranged down the sluiceway to feed the ash to one of two ash-crushers. The sluiceways are lined with cast basalt tiles. The crushed ash is passed to a further sluiceway provided to convey the dust by gravity to the ash sump. Three "Hydroseal" ash-pumps of 4,000 gal./min. capacity and driven by 235 h.p. motors running at 730 r.p.m. are provided to pump the ash and dust through one of two cast-iron pipe lines to the settling ponds. Duplicate pumps driven by 7½ h.p. motors running at 1,450 r.p.m. are provided to supply clean sealing water to the ash-pumps. Any one of the ash-pumps can be selected to automatically pump overflow water to the ponds during non-ashing periods. High-pressure water is provided for the sluiceways and ash-hopper feed nozzles by one of two 1,500 gal./min. sluicing-pumps, powered by 180 h.p. motors running at 1,460 r.p.m. These draw water from the C.W. main. Water balance in the ash-sump is maintained by a 12-in. thrustor operated make-up valve, with "Noflote" control. Lancashire Dynamo & Crypto Ltd. supplied the pump motors for this installation, together with two 15 h.p., 475 r.p.m. motors for the ash-crushers.

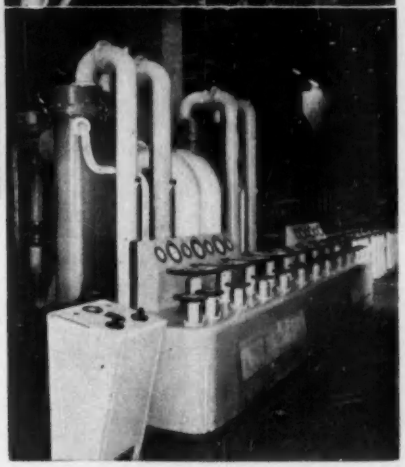
Redler Conveyors Ltd. supplied twelve 9-in. conveyors, arranged to handle 8½-tons per hour of dust from the precipitator hoppers. This equipment has been designed to cater for the slight pressure differential compared with atmosphere ; rotary sealing valves being interposed between each conveyor discharge and the main ash




*(Above). The Worthington-Simpson extraction-pump and stilling chamber associated with one of the condensing and feed-heating plants.*



*(Above, right). The completed station houses six 60-MW turbo-alternator sets supplied by the General Electric Co. Ltd., each designed to operate with steam conditions of 900 lb./sq. in. and a temperature of 950 deg. F. at the turbine stop-valve.*

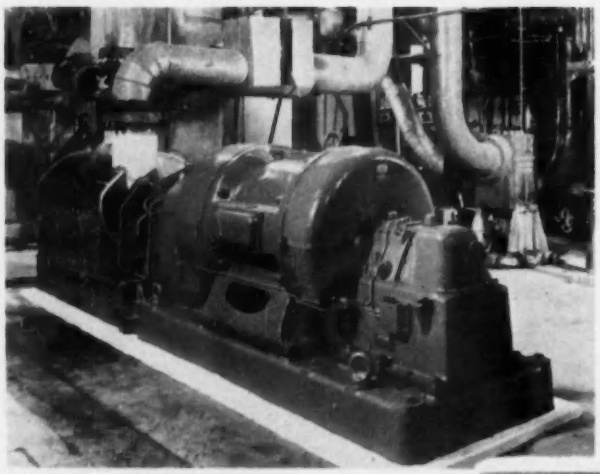


*(Right). A view showing the Worthington-Simpson steam-ejectors and gauge panel.*

sluice, thus ensuring efficient dust-free handling of the fly-ash under practically any conditions.

**Turbo-alternator plant**

The six 60-MW turbo-alternator sets were supplied by the General Electric Co. Ltd., each being designed to operate with steam conditions of 900 lb./sq. in. and a temperature of 950 deg. F. at the turbine stop valve, and running at 3,000 r.p.m. Each turbine exhausts into a Worthington-Simpson Ltd., twin-shell condenser, having a total heating surface of 52,000 sq. ft., and designed to maintain a vacuum of 28.2-in. Hg. when dealing with 382,145 lb./hr. of steam, and when supplied with 35,000 gal./min. of circulating water at 74.5 deg. F. A vacuum of 28.7-in. Hg. can be maintained when dealing with 372,130 lb./hr. of steam and 35,000 gal./min. of circulating water at 63.5 deg. F. Condensate is withdrawn from the condenser by two 100 per cent. duty horizontal extraction-pumps, each driven by screen-protected horizontal spindle, squirrel-cage motors, running at 970-r.p.m. Two sets of air-ejectors are provided, one designed to operate with steam at 720 lb./sq. in. pressure, and the other at 450 lb./sq. in. A starting ejector, which also operates with steam at a pressure of 450 lb./sq. in., is available for raising the vacuum quickly when the set is being started up. From the ejectors the condensate is passed through a drain-cooler and two l.p. feed-heaters to a deaerator, then through a feed-pump to two l.p. heaters, and finally at a temperature of 385 deg. F. to the boilers. The flow of water into and out of the system is controlled by the water-level in the deaerator storage-tank.



Cooling water for each twin-shell condenser is delivered by two Mather & Platt Ltd. vertical "Lonovane" circulating-water pumps, each designed for a capacity of 18,200 gal./min. at a temperature of 85 deg. F., driven by 485 h.p., 3-phase, 50 c/s, 3,300-V direct-on started Mather & Platt motors, at 750/735 r.p.m. These pumps also supply the water for the hydrogen and oil coolers. The water supply is drawn from the cooling tower ponds, and is returned to the central discharge tanks inside the towers, via the twin-shell condensers themselves.

The chlorination plant manufactured by Wallace & Tiernan Ltd. is designed to treat intermittently, and in turn, the water being delivered to the condensers by each circulating-water pump, the frequency and duration of chlorination being governed by a central programme-controller. It is expected that a chlorine residual of up to 2.0 p.p.m. will be necessary to destroy the nucleus of any slime fouling in the associated coolers under the worst water conditions, and that normal treatment periods will be of an average duration of 5-min. at 3 or 4 hourly intervals. The sequence of operation is initiated from the programme clock-control panel which activates a rate-controller enabling six different meter settings to be selected automatically, one for each set, if varying conditions at the application points demand this.

There are three ferro-concrete cooling towers designed by Film Cooling Towers (1925) Ltd., the cooling capacity of each being from 3.9 to 4.8-million gal./hr. through a temperature range of 16 to 20 deg. F. Each tower is 350-ft. above the normal station ground level and has a diameter at the base of 242-ft. and at the top 156-ft. Circulating-water from the condensers is pumped through a central reinforced-concrete stack to a circular discharge-chamber from where it is distributed over the area of the tower by means of timber channels to fall by gravity through porcelain outlets on to 3,450 glazed porcelain sprayer-pots and then through wooden lattice work into the ponds. The lattice-work represents an effective cooling surface of 1,635,000 sq. ft.

*(Left). Two 630,000 lb./hr. feed-pumps each driven by a Metropolitan Vickers 1,380 h.p. 3,000 r.p.m. motor were supplied by G. & J. Weir Ltd. for each boiler.*
*(Below). A view in the station main control room.*

The make-up water for the towers is supplied from the pumping-station and passed through two 700,000 gal./hr. rotating screens, manufactured by Richardsons Westgarth & Co. Ltd., and pumped to the cooling tower ponds by four Worthington-Simpson vertical centrifugal pumps, three of which will provide the normal duty of 9,000 gal./min. for the six turbines. The pumps are operated remotely from the control-room, and are driven

by 105-h.p., 1,470-r.p.m. standard screen-protected, squirrel-cage, induction motors, supplied by Laurence, Scott & Electromotors Ltd.

Each boiler is served by two feed-pumps. These were supplied by G. & J. Weir Ltd., and are 8-stage, ring-section Electrofeeders, fitted with a relay-operated automatic by-pass valve. Each pump has an output of 630,000 lb./hr. at a discharge pressure of 1,245 lb./sq. in. The suction temperature of these units is 277 deg. F. The make-up water required is drawn from the Birmingham Corporation's Whiteacre pumping station and is treated in two " Permutit," fully-automatic, ion-exchange water-softening plants. The softeners are shut down alternately, after a pre-set quantity of water has been treated, and regeneration is initiated. The ion-exchange material is regenerated with brine, and the regeneration procedure is effected automatically, the various flows and brine injection being controlled by a motor-driven automatic multiport valve. Each unit is designed to provide a maximum flow of 6,300 gal. of treated water per hour, the total capacity of each softener between regeneration being 30,300 gal. The treated water is passed to three 24,000 gal. storage tanks.

Six live-steam, triple-effect evaporators supplied by Aiton & Co. Ltd., draw their water supply from the storage tanks. They are arranged in three pairs, each unit being designed for a capacity of 25,000 lb./hr. of distillate, which is discharged to the reserve feed tanks associated with the turbines.

The alternators associated with the General Electric turbines, will give the full 60-MW output at 0.8 p.f., and generate at 11.8-kV. They are direct-coupled to transformers stepping up to 132-kV at which pressure they are switched on to the grid. The alternators are hydrogen-cooled at a pressure of 0.5 lb./sq. in., the hydrogen-coolers being supplied by Premier Cooler & Eng. Co. Ltd. Each machine has a separate motor-driven exciter which is situated in the switchgear bay at operating-floor level alongside the machine it serves.

The building of the " C " station made it desirable to reconstruct the 132-kV substation associated with the " A " station, and to add the necessary circuits for the " C " station generators and outgoing feeders. The new substation is of the outdoor type employing ferro-concrete structures to carry the busbars and isolators. Provision is made for a total of 35 circuits which includes six generators, two station transformers, four grid transformers, four connections to the adjoining 275-kV supergrid substation, the remainder being 132-kV feeders, bus section and bus coupler circuits, and three interconnectors to the existing Hams Hall " B " substation. The circuit breakers are of the air-blast type of 3,500-MVA breaking capacity remotely-controlled from a central control room, excepting the generator and station transformer circuit breakers which are controlled from the " C " station control room. The four grid transformers have a total capacity of 195-MVA and are connected to the 11-kV busbars in the " A " station and the 33-kV busbars in the " B " station. Buildings on the site accommodate protective gear, batteries, etc.

## POWER STATION EFFICIENCIES

THE annual statement in respect of the thermal efficiencies of power stations of the Central Electricity Generating Board has just been issued. It shows that last year nearly 1¼ million tons of coal was saved in the Board's power stations in England and Wales as the result of increased efficiency of operation. This fuel saving represents a reduction in operating cost of about £5 million. The overall average thermal efficiency during the twelve months was 25.38 per cent. compared with 24.70 per cent. for the previous year. Of nearly 78,000 million units supplied from these stations, nearly 30 per cent. was provided by the 20 most efficient stations operating throughout 1957. These 20 stations had an average efficiency of 29.45 per cent., their individual efficiency percentages being as follows :—

| Stations | Thermal efficiency (per cent). |
|---|---|
| Castle Donington, near Derby | 31.92 |
| Drakelow, Burton-on-Trent | 31.02 |
| Littlebrook " B," Dartford, Kent | 30.20 |
| Stourport " B " H.P., Worcs | 30.08 |
| Wakefield " B," Yorks | 30.07 |
| Portishead " B," near Bristol | 29.97 |
| Stella South, near Newcastle upon Tyne | 29.90 |
| Meaford " B," Stone, Staffs | 29.83 |
| Stourport " B " L.P., Worcs | 29.70 |
| Stella North, near Newcastle upon Tyne | 29.32 |
| Hams Hall " C," near Birmingham | 29.17 |
| Ince, near Ellesmere Port | 29.13 |
| Barking " C " | 29.10 |
| Battersea " B " | 29.08 |
| Dunston " B " II, Newcastle upon Tyne | 29.01 |
| Marchwood, near Southampton | 28.95 |
| Skelton Grange, Leeds | 28.83 |
| Carrington, near Manchester | 28.75 |
| Tilbury | 28.71 |
| North Tees " C," Middlesbrough | 28.53 |

Heading the list is Castle Donington (East Midlands Division) which is the first station to commission single boiler/turbo-alternator units of 100-MW rating. This station, with a thermal efficiency of 31.92 per cent., displaces Littlebrook " B " which headed last year's list with a figure of 30.62 per cent. Drakelow, which occupied second place last year, with 30.54 per cent., is second again this year with 31.02 per cent.—an increase of 0.48 per cent.

### GOVERNMENT LOAN SCHEME FOR FUEL SAVING

In the House of Commons on Friday May 23rd Mr. McAdden asked what change of policy was in mind in regard to the type of projects, elegible for loans under the Government Fuel-Saving Loans Scheme? Sir Ian Horobin, Parliamentary Secretary to the Ministry of Power, said in a written reply : " In present circumstances, the resources available for the Government Fuel Saving Loans Scheme are necessarily restricted and must be concentrated on schemes most likely to be of direct benefit to the country, particularly those leading to a reduction in the demand for large coal. In future, the amount of any loan will not exceed £25,000. Within this limit provision will continue to be made for schemes which do not involve any change in the fuel used. Loans for conversions from one type of fuel to another, however, will only be approved where there is a worth-while fuel saving, and where the change will release substantial quantities of large coal in relation to the capital expenditure involved."

As a result of continued expansion in Europe, and in order to offer the German market the best possible service, **George Kent Ltd.** announce that a Branch Office is in the process of being established at Krefeld in the heart of the industrial Ruhr. This latest addition to the Kent Organisation will have both commercial and technical sales managers, while the skilled technical staff will be supported by a comprehensive service and spare-parts department covering the whole of the Kent range of products. The address of the office is George Kent Ltd., Zweigniederlassung fur Deutschland, Krefeld—Westparkstrasse, 54 (Telephone 25692—Telegr. Kents Krefeld).

Thompson Bros. (Bilston) Ltd., Bradley Engineering Works, Bilston, Staffs., announce that **Mr. E. E. Pheasey,** M.B.E., M.Inst.B.E., has been appointed works director.

# Heat and Power for Western Europe

IN his presidential address to the Institute of Fuel recently Mr. H. McNeil, B.E., M.I.Mech.E., M.I.E.E., F.Inst.F. (managing director, Babcock & Wilcox Ltd.), outlined some of the more important factors affecting fuel requirements and the supply of fuel for the next 10 to 20 years in Great Britain, France and Germany. Analysing the likely trend of fuel demand by the chief consumers, Mr. McNeil dealt first with electricity generation and pointed out that ever since the commercial supply of electricity started over seventy years ago, the demand has doubled every ten years. This statement is reasonably correct for both Western Europe and the United States, even though the present installed capacity in the U.S.A. is about 50 per cent. greater per head of population than in the United Kingdom, and the ratio of available power in the U.S.A. to that in France and Germany is more than double.

There is no sign, even in the United States, of any falling off in the rate of increase in demand, and it is reasonably certain that the demand in Europe will tend to get nearer to the U.S. figure rather than the reverse. This continuous increase was partly accounted for by a continuously rising domestic demand, but the main increase in electricity demand comes from industry, partly in the form of mechanical devices replacing muscle power, but even more by the use of mechanical means to obtain results otherwise impossible. Direct industrial uses for electricity, in very large quantities, as in the electro-chemical and electro-metallurgical industries, were also likely to increase. Except for extraneous causes, efficiency of generation has continued to improve throughout the whole life of the industry, but this improvement has been irregular, owing to the ways in which improvement has been obtained. In the very early days of the industry, low-pressure saturated steam was used with reciprocating engines as the prime movers. In due course, two important developments followed very quickly—viz. the use of steam turbines, and the general adoption of superheated steam. Both these developments contributed very substantially to the steam cycle efficiency. There has, of course, been no drastic change in the lower temperature end of the cycle, although there has been some gain from a steady improvement in the aerodynamic design of turbine blading. On the other hand, increasing metallurgical skill has continued to permit the use of higher and higher steam temperatures. Further improved cycle efficiencies have been attained by increasing steam pressure with the same upper temperature limit, but preventing undue moisture in the turbine, by reheating at an intermediate pressure. Yet another important contribution to cycle efficiency was the introduction of regenerative feed-heating. Both these latter developments date from 1921, when the North Tees Station, the pioneer of the present design of steam cycle, was commissioned. But it was not until individual boiler size was increased to match the steam demand of one turbine that the operating complications of the reheat cycle were generally considered to be outweighed by its higher efficiency.

One may reasonably expect that, within the next ten years, the efficiency of new plant installed in central stations, when using fossil fuel, may be of the order of 40 per cent.—corresponding to an annual reduction of 2 per cent. in fuel consumption, as against the figure of 31.53 per cent. on " units sent out " for the most efficient British station in 1956-57. However, the average efficiency will be governed to a very large extent by the rate at which old plant is taken out of service. The next ten years should see the end of all pre-war equipment and, although many of the immediate post-war installations were of 1939 design, one can safely postulate an annual improvement in average thermal efficiency of 0.5 per cent.

This gave an increasing fuel demand for electricity generation of $5 \pm 0.5$ per cent. per annum (compounded) which would be applicable to France and Germany also. The total fuel (coal plus the coal equivalent of oil and water power) used for the purpose in this country in 1955 was 44.8 million tons, which would increase by 1965 to between 69 and 76 million tons and by 1975 to between 107 and 130 million tons.

France used 24 million tons in 1954, and taking into account that 40 per cent. of electricity requirements came from hydro-electric sources, the fuel required (in coal equivalent) would reach approx 40 million tons in 1965 (including the equivalent from water power) ; by 1975 thermal needs, allowing for water power, will be between 33 and 47 million tons of coal per annum.

In Germany, hydro power accounted for the equivalent of 5.75 million tons of coal in 1955. Power stations owned by public supply companies or municipalities used 18.6 million tons of coal as black coal or its equivalent in brown coal. The water-power production is not expected to increase to any important extent while the fuel consumption may be expected to be between 30.8 and 33.6 million tons in 1965, rising to 48 to 56 million tons in 1975. In Germany, however, there is no equivalent of the nationalised electricity organisations of Britain and France, and the industry has developed along lines of its own. Many more industrial plants generate their own power, and some—the mining industry in particular—sell power in bulk to the electricity distributing companies. Industrial generation of electric power amounts, in the United Kingdom, to only 8 per cent. of the total ; but in Germany, this figure is over 37 per cent. The electricity supplied to public distributing authorities by pit-head stations, owned by the mining companies, was equivalent to 3 million tons of coal in 1955.

For the U.S.A., the fuel consumption, in equivalent tons of coal, was 319 million tons of coal plus $52 \times 10^9$ kWh of electricity from hydro-electric generation in 1953. As the U.S.A. in this direction are already so far ahead of Western Europe, and proportionately further ahead of the rest of the world, one hesitates to accept the same rate of increase, but—taking the lower of our limits, and assuming that hydro-electric power keeps up its proportion—the fuel demand in 1965 will be 440 million tons of coal or its equivalent in oil, gas or other forms of thermal energy.

Figures for consumption of fuel and energy for various

purposes, and in particular for the gas industry, the steelmaking industry, for transportation and for general industry and domestic uses, were given in the address. All these considerations led up to the conclusion that the overall fuel requirements, expressed in millions of tons of coal equivalent, were likely to be—for Great Britain about 368 in 1965 rising to 460 in 1975, the corresponding figures for France being 155 and 220, and for Germany 236 and 318.

**Energy supplies**

In taking a cursory glance at the methods to be adopted to fulfil the needs outlined in the foregoing, it can reasonably be assumed that in Western Europe the coal-mining industry will not expand at a sufficiently rapid rate to match the total energy requirements. For Great Britain, the assumption is that the petrol consumed by road and air transport will be almost entirely refined in this country and that the quantity of petrol required will govern the minimum amount of crude imported. Although there is some flexibility in refinery operation, we should not be too far out in assuming that the ratio of petrol to crude will not vary very much.

On this basis, we arrive at a net figure to be supplied from indigenous coal and other resources, of the equivalent of 295 million tons of coal per year in 1965, rising to 355 million tons in 1975. The domestic production of coal is expected to rise to about 245 million tons in 1965, but not to increase much thereafter. This means that in less than ten years' time we will be 40 million tons of coal or its equivalent short of our requirements. With little or no hydraulic power available, we have only two alternatives :—either to import oil beyond the balanced quantity required to meet our internal combustion engine needs, or to cut the demand of the electrical power industry by using nuclear heat. There is no prospect of generating enough electricity from nuclear energy to save 40 million out of the 70 million tons of coal equivalent which the electrical industry will need in 1965. The first nuclear power stations ordered by the Electricity Authority in this country were calculated to be economic on a load factor of approximately 80 per cent. It is expected that future designs of nuclear power stations will have a considerably lower capital cost per kW of effective output. This would reduce the load factor at which they would be economic, and the overall benefit of installing these stations would be correspondingly increased. Actually, the proposed rate of installation of nuclear plant allows for the equivalent of only about 5 million tons of coal per year, on the basis of the Government White Paper, although technical improvements and an acceleration of this programme make it more likely that the figure will approach 10 million. Even on this rather optimistic basis, it would still be necessary to envisage the importation of around 30 million tons of coal or its equivalent each year by 1965, over and above the importation of enough crude petroleum to give our requirements for motor spirit, etc. Perhaps this need could best be met by importing additional quantities of crude petroleum, as it would imply refining the crude in this country and exporting the surplus refined products.

The picture in France is rather different. Here there is still further expansion of hydro-electric generation envisaged, with a total production in 1965 of the equivalent of 18 million tons of coal, and it is expected that this can be still further increased to 28 million tons by 1975. This must represent almost the limit of economic development of water power.

In Germany the picture is very similar to that in Great Britain. The nuclear programme is less defined than in France and Britain, so import estimates are not too exact, but they are likely to amount to 20 to 27 million tons of coal equivalent in 1965, rising to 30 to 37 million tons in 1975. It is thus seen that in Western Europe, as represented by its three most populous and best endowed countries, there will be a need in 1965 for 175 to 195 million tons of imported coal equivalent. Much of this, probably 100 million tons, would be imported as petroleum to meet the needs of motor cars and aeroplanes, but the balance could be in any convenient form, and the source of supply would be determined by economic considerations. Western Europe, as a whole, is not lacking in coal resources, but apparently it finds it is more attractive to buy its thermal requirements than to produce them from its own mines.

In the very long-term picture it is likely that all our power and heat requirements can be met by the fusion of hydrogen isotope nuclei, but the chances of any commercial production from this process before 1975 can probably be neglected. In the meantime, it is desirable that we should use to the full the sources of heat of which we know but some of which are neglected at present. There are many waste products of industrial processes which can yield a useful heat output from suitable equipment. Some are already used, e.g., coke breeze and spent tan in this country, and bagasse or black liquor in other countries, but there may be more which are not yet appreciated at their true worth as fuels.

There is one other line of development which holds out promise but which has only been tackled on a small scale so far, and that is underground gasification of coal. This process might seem at first sight to be rather wasteful but the results achieved on pilot-scale experiments indicate that the efficiency of extraction may be as high as is achieved in normal mining practice. Immense advantages in the reduction of underground labour and reduced danger would surely offset many of the disadvantages. So many power stations will, in the future, need to be equipped with cooling towers because of shortage of riverside power station sites that there is no reason why they should not be sited close to the fuel.

It will be noted that the variation of fuel consumption between Great Britain, France and Germany is very large compared with the population difference. In 1955 the consumption of energy was 4.9 tons of coal or equivalent per head in Britain, as against 2.6 tons in France and 3.4 tons in West Germany. The forecast figures already given show this disparity continuing. Before we can assume this we must consider the reason for it. In Britain a large proportion of the national effort has to be devoted to manufacturing in order to export sufficient goods to make up our deficiencies, particularly those in agriculture. France, on the other hand, is self-supporting in most respects. The position in Germany is quite similar to that in Britain. There may be a more efficient use of fuel in Germany than in the U.K., and because of this the gap between the fuel consumptions of Britain and Western Germany may narrow, whereas that which exists between Britain and France may be expected to continue.

# New Boiler Plant at Vauxhall Motors Works Extension

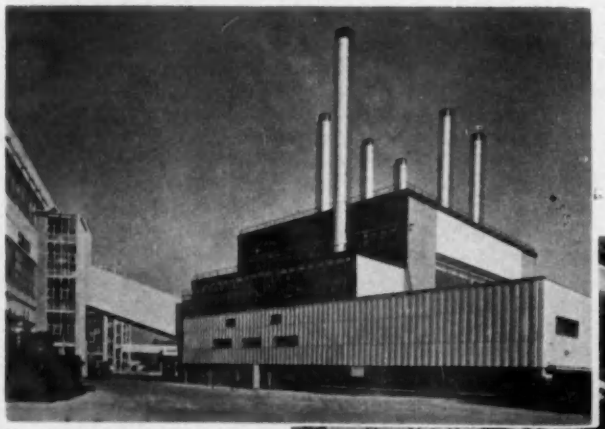
A scheme for doubling the production capacity of Vauxhall Motors Ltd., conceived in 1954 as a five-year project, was completed during the latter part of April this year: £36 million has been spent in that period, and the company now have the resources to produce some 250,000 cars, vans and trucks per year. The main features of the scheme have been the construction of a completely new building covering an area of 1½ million sq. ft. at Luton; the extension of the company's Dunstable plant from 120,000 to 1¼ million sq. ft.; the re-equipment of the machine shops at Luton; and the erection of a new building covering an area of 500,000 sq. ft. at Dunstable to accommodate the company's parts and accessories activities.

Before the expansion scheme began, the Luton plant produced both cars and commercial vehicles, the small factory at Dunstable being used only for the manufacture of a limited number of non-current components. To permit a greatly-increased scale of passenger car production at Luton, it was necessary to remove truck manufacturing operations to a new location, and the decision was taken to enlarge the Dunstable plant to house all Bedford truck-manufacturing and assembly activities except the production of steel cabs, which would continue to be carried out at the main Luton works.

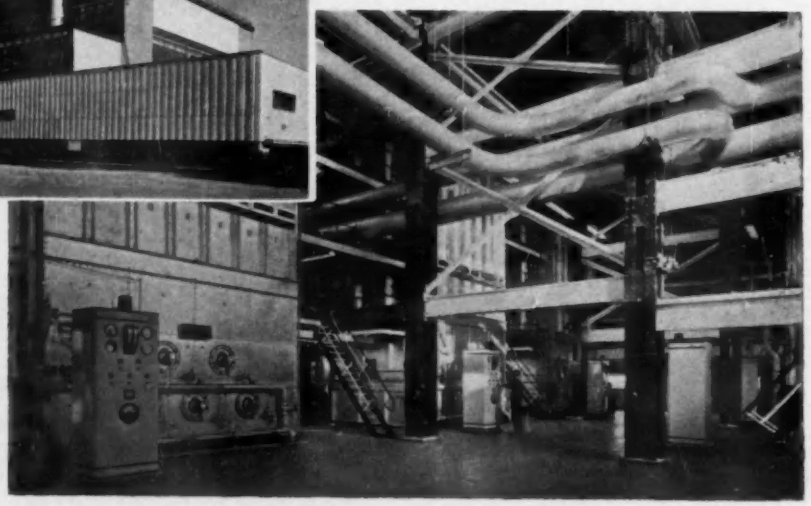
The new passenger-car building at Luton contains press shop, body-building, paint and trim shops, and final assembly operations. Finished mechanical components are fed into it by conveyor from other buildings The new press shop houses 222 new presses, of which 130 are heavy presses ranging from 72-in. to 156-in. in width. Most of these are of the underdrive type, mounted above a continuous basement which contains a scrap-metal conveyor system. The paint shop is equipped to spray car bodies and sheet metal components automatically by means of mechanically-operated spray guns, which move in a path following the contours of the car as the body-shell moves on its conveyor through the spray booths. Other buildings erected under the expansion programme at Luton include an extension to the die shop, a boiler and compressor house, a paint-mix building, oxygen and acetylene stores and a comprehensive plant for the treatment of trade effluent.

**Boiler installation**

The new boiler house is situated near the south-east corner of the new passenger-car building. It is a steel-framed structure of brick and reinforced concrete, with asbestos cladding, covering a total area of 18,540 sq. ft., and adjoining it on the south side is the compressor house. An unusual aspect of the building construction is the low-roofed ground-floor area which accommodates the water-treatment plant, electrical switch-gear, oil pumping and heating units, and the various mains, conduits and pipe-lines leading to and from the main firing-floor above. The advantage of this arrangement is, of course, the ease of accessibility for maintenance purposes. Two steam boilers and five high-pressure hot



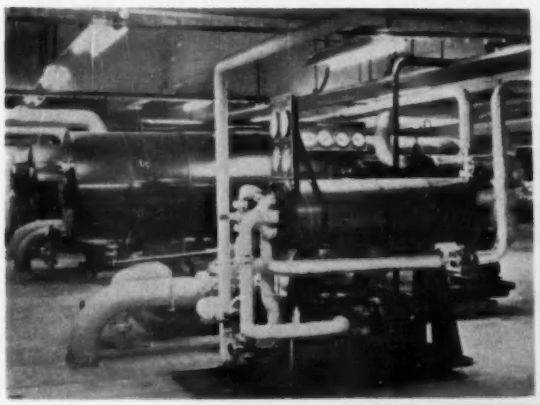
*(Above). An exterior view of the new boiler house at Luton.*



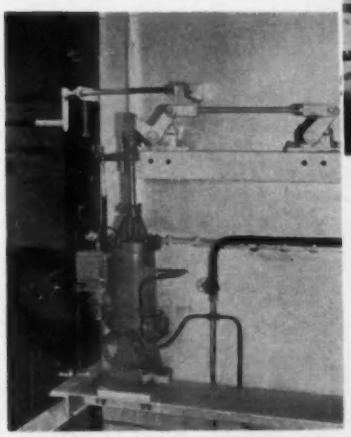
*(Right). Three of the five La Mont high-pressure hot-water boilers, each of which has a maximum continuous capacity of 75-million B.Th.U./hr. at 250 lb./sq. in. and 350 deg. F.*

water boilers are installed, and these cover the requirements of both process and space-heating loads of the majority of the factory, including the new passenger-car building. All the boilers are oil-fired, the oil being delivered by road-tanker and stored in two outdoor storage tanks with a total capacity of 48,000 gallons. The tanks are fitted with high-pressure hot water heating coils, and thermostatically-controlled electric heaters.

The two steam boilers were supplied by Combustion Engineering Inc. of America, and are of the packaged type, each rated at 27,500 lb./hr. at 350 lb./sq. in. and 431 deg. F. At the present time, however, the boilers are operating at 250 lb./sq. in. Both units are of the single-pass, water-tube design, each with a furnace volume of 675 cu. ft., and a total heating surface of 3,095 sq. ft. They fired through steam-atomising burners, the oil supply being taken from the storage tanks via a 3,200 lb./hr. capacity heating and pumping unit, supplied by Hamworthy Engineering Co. Ltd. Each burner is provided with a flame-failure device, and initial lighting-up, utilising Calor gas, is by an electronically-controlled automatic cycle.



*(Above). The oil heating and pumping units supplied by Hamworthy Engineering Co. Ltd.*



*(Above). View in the boiler house, showing circulation pumps for both steam and hot-water supplies to the factory area.*

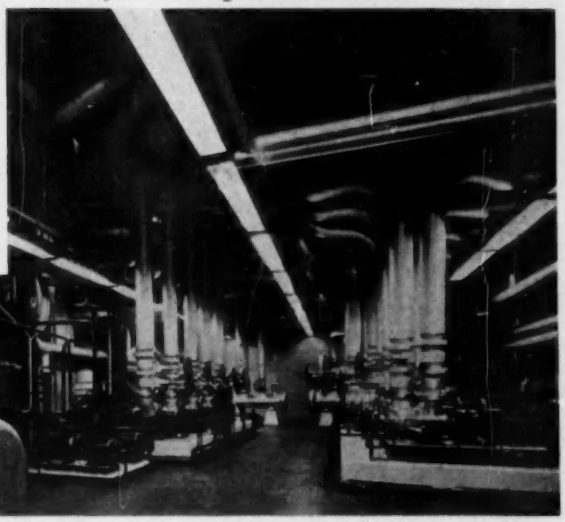
*(Left). A Kent power cylinder controlling the forced-draught to one of the La Mont high-pressure hot-water boilers.*

One F.D. fan is provided for each boiler. These were manufactured in the U.S.A., and are of the duplicate-type, powered by a 10 h.p. motor operating at 1,450 r.p.m., with output control by a vortex damper. As the boilers operate under pressure furnace conditions no I.D. fan is provided.

The boilers are arranged for fully-automatic operation, and are controlled by limits of high-pressure and low water; with modulating controls, the boiler output follows the steam demand. Berry Hill (Engineers) Ltd. supplied the feedwater pumps for the steam boiler installation, and these are electrically-driven, 8-stage units designed to operate at 350 lb./sq. in., and each having a capacity of 7,000 gal./hr.

**High-pressure hot water boilers**

The five high-pressure hot water boilers were supplied by La Mont Steam Generator Ltd. Each unit has a maximum continuous capacity of 75-million B.Th.U./hr. and operates on a nitrogen-pressurised system at a maximum pressure of 250 lb./sq. in., and a flow temperature of 350 deg. F. The boilers are of the La Mont forced- and controlled-circulation type, each having a combustion chamber which is partially water-cooled and partially air-cooled, with a total heating surface of 12,750 sq. ft. As mentioned previously the boilers are oil-fired, but the design of the boilers and the boiler house building is such that conversion to coal-firing with travelling-grate stokers could conveniently be carried out if circumstances warranted such a change.



Each boiler is provided with balanced draught, the fans being of Davidson & Co. Ltd. manufacture. The F.D. fans are designed for a capacity of 24,000 cu. ft./min., whilst the I.D. fans are designed for a capacity of 40,000 cu. ft./min. The forced draught system is so arranged that the air inlet to the fans is at high-level in the boiler house, whilst on the discharge side the air is taken under the combustion chamber hearth to the front windbox casing. This arrangement has the advantage of increasing the air temperature to the burners by some 30 deg. above the air temperature at the firing-floor level, thus providing useful boiler house ventilation with a consequent increase in operating efficiency.

Each boiler is fired by five pressure-jet burners supplied by Hamworthy Engineering Co. Ltd. The plant uses extra heavy fuel oil with a viscosity of 3,500 seconds Redwood No. 1 at 100 deg. F. and is suitably préheated to a temperature of 270 deg. F. at the burners. Three oil-fuel pumping and heating units, also supplied by Hamworthy, are provided, each set having a capacity of 20,000 lb./hr.

Water for both the steam and hot water boilers is treated in a Permutit Co. Ltd. "Deminrolit" plant, which is capable of providing 1,000 gallons of pure water per hour. In the steam system, the condensate passes to a high-level de-aerator, and the make-up water from the Permutit plant enters the system at this point. The steam system is totally-enclosed, and the condensate is returned to the de-aerator by means of condensate pumps which maintain a continuous pressure of 10 lb. in the condensate lines.

**Nitrogen-pressurising equipment**

The nitrogen-pressurising equipment for the hot water system comprises a fusion-welded pressure vessel, 6-ft. diam. by 12-ft. high, and fitted with water gauges, pressure gauge, level valves and a Mobrey high and low water level alarm. Nitrogen from a battery of cylinders is discharged into the pressure vessel as required to maintain the system at a working pressure of 200 lb./sq. in. Two electrically-driven pumps, each designed for a capacity of 30 gal./min. at a head of 562-ft., and automatically-controlled by pressurestats, are provided to enable water to be drawn from two cast-iron expansion tanks with a gross capacity of 20,000 gallons, and pumped into the system.

**Instrumentation and control**

The necessary instruments and control panels for both the steam and hot water boilers were supplied by George Kent Ltd. The boiler and distribution panels are situated in a separate control room, the boiler automatic-control panel being divided into sections, each containing the instrumentation for one boiler. For each of the two package-type steam boilers the instruments consist of a Commander combined steam-flow and pressure recorder, combined water-flow and temperature recorder, and oil-flow indicator/receiver measuring oil-fuel to the burners. This latter receiver is operated from a differential-pressure transmitter at the orifice location. Flue-gas conditions are recorded by a Multelec combined oxygen and temperature recorder. A single cubical panel mounted in front of these boilers contains combined instrumentation for both boilers, consisting of two smoke-density indicators, a fuel-oil-temperature controller, and a fuel-oil pressure controller.

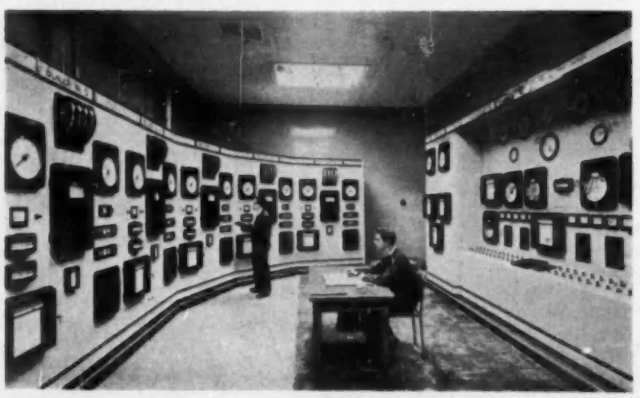
The instrumentation for each hot-water boiler consists of four draught gauges measuring draught at combustion chamber, boiler outlet, forced-draught fan and burner windbox. Commander flow indicators are provided for water and oil flows, the oil-flow measurement being effected by a differential-pressure transmitter at the orifice location. Flow and return water temperatures are measured by two edgewise indicators. A Multelec recorder gives a combined record of the oxygen content and temperature of the flue gases. Induced draught is controlled by an FAF furnace-pressure controller actuating the induced-draught fan power cylinder. The power cylinder for the forced-draught fan is positioned by a ring-balance air-flow controller, the desired-value index of which can be manually set from the panel. In front of each hot water boiler is a cubical panel containing gauges and repeat indicators for the guidance of the boiler attendant, as follows: two draught gauges tapped into the combustion-chamber and burner windbox lines respectively; a smoke-density indicator which is wired into the boiler-control panel circuit; and gauges for boiler pressure and boiler differential-pressure respectively.

**Circulation systems for factory area**

The high-pressure hot water circulation to the factory area comprises two systems, one supplying water for heating and one for process work. Both lines are taken from a ring main within the boiler house into which all the hot water boilers are connected. The heating circulation is maintained by five electrically-driven pumps supplied by Holden & Brooke Ltd., each with a capacity of 1,150 gal./min. Process demands are met by three electrically-driven pumps, also of 1,150 gal./min. capacity, and three electrically-driven pumps of 2,200 gal./min. capacity, supplied by Berry Hill (Engineers) Ltd.

The distribution panel which faces the boiler automatic-control panel in the control room is fitted with Commander circular-scale indicator transmitters and Multelec B.Th.U. recorders to indicate and record the distribution of heating supplies to the various parts of the works. The centre section of this panel contains pressure gauges for fuel oil, pressure vessel and heat exchangers; Universal pH and also conductivity recorders for feedwater; Commander indicators and recorders for water and steam flows to the heat exchangers and steam flow to ovens.

In addition, there is a Commander indicator measuring head-tank level; a two-point recorder measuring flow and return temperatures from the heat exchangers; a Multelec air-temperature recorder; and four head-pump controllers. A central desk-panel section contains the push buttons for the pumps and a 24-point switch box.



*A view in the boiler plant control room, which contains the instruments for both the steam and hot-water installations.*

# Anglo-Italian Collaboration in Nuclear Power Plant Construction

A LONG term agreement for collaboration between AGIP Nucleare of Milan, and the Nuclear Power Plant Company Ltd., Knutsford, Cheshire, was signed in London on May 2nd by Signor E. Mattei, president of both AGIP Nucleare and its parent organisation Ente Nazionale Idrocarburi (ENI), and Sir Claude Gibb, K.B.E., F.R.S., chairman of the Nuclear Power Plant Company.

This agreement provides for collaboration in the construction of nuclear power stations in Italy over a minimum period of seven years. It covers the exchange of information on the design, construction and operation of nuclear power stations, the training of technical staff, and collaboration in research. It also paves the way for a second agreement (due to be concluded shortly), which will provide for the construction of a nuclear power station with a single graphite-moderated gas-cooled reactor and a guaranteed output of 200-MW. The station will be constructed for the Societa Italiana Meridionale per l'Energie Atomica (SIMEA), an organisation owned jointly by AGIP Nucleare and the Instituto per la Ricostruzione Industriale (IRI). AGIP Nucleare, which was formed in 1957 and which is one of the five main concerns which go to make up the Italian state-controlled organisation Ente Nazionale Idrocarburi (ENI), will undertake the civil engineering and building work in close co-operation with the Nuclear Power Plant Company, and will also be responsible for the correct manufacture and testing of all components to be made in Italy. The British company will be responsible for the overall design of the station and for its satisfactory commissioning, and will supply the major components, including the reactor itself with its ancillary equipment, the heat-exchangers or steam generating equipment and the turbines. The station will be built on a site near Latina about fifty miles south of Rome ; work is expected to begin by the end of this month and to be completed during 1962.

The overall design of the 200-MW station has been provided by the Nuclear Power Plant Company, but the detailed design will proceed in collaboration with AGIP staff, who will adapt it to suit local requirements as well as Italian practice and standards. At a Press conference following the signing of the agreement, Sir Claude Gibb said that the signing was the first stage of the negotiations which have been running for almost a year ; and although it has been a long road it has been a very happy one. On the British side, they have felt that at all stages they had the goodwill, the determination of both sides to build nuclear power stations in Italy on a joint basis, and to make them successful.

The exact capital cost of the first station could not be given until the actual site had been surveyed in detail, but it would probably be something over £20 million. Of this, rather less than half would be spent in Britain. In future stations, this ratio would probably be still lower. Operating costs would be about 6-7 lire per kilowatt-hour or less than 1d. a unit. The station would be competitive with conventional power-stations. Sir Claude also said that the Atomic Energy Authority had acted, and would continue to act, as consultants, and arrangements covering the supply of nuclear fuel had been ratified by the British and Italian Governments. The reactor pressure-vessel, about 67-ft. in diameter, would be made of " orange-peel " segments pressed in Britain, of British steel, which would be welded together on the site. Italian steel might be used in future stations. Turbines and generators were among the other British-made components. Though mainly conventional, they required certain special features for nuclear work, and there was not time to train Italian manufacturers to build them for the first station. A number of engineers, from the N.P.P.C., were already working at the laboratory set up by AGIP outside Milan helping to establish Italian standards for the pressure-vessel, corresponding broadly to the Lloyd's inspection standards used at Bradwell. Other components would conform to Italian standards where necessary, including the use of metric threads at the terminal points. Earthquake precautions would be taken, as indeed they were even in Britain. Italian engineers were working in the N.P.P.C. offices in this country.

The Italian nuclear power programme anticipated the installation by 1967 of ten stations with a total installed capacity of 2,000-MW. This was a most ambitious programme, assuming that it meant ten stations similar to the present one, and AGIP Nucleare could not expect to undertake it all ; but in collaboration with N.P.P.C. they would have more

*Left to right: Signor E. Mattei, President of AGIP Nucleare· Sir Claude Gibb, Signor G. Martinoli and Mr. H. H. Mullens (joint managing director Nuclear Power Plant Co.) at the Press conference to announce the signing of the agreement between N.P.P.C. and AGIP Nucleare.*

" probability of success as more technicians are trained and informed and able."

**Need for collaboration**

On the general question of British trade in the field of nuclear engineering, Sir Claude pointed out that manufacturers in this country were trying to amortise the huge expenses incurred in research, by selling their products in the greatest number possible of foreign markets. They were nevertheless aware that the requirements of the importing countries which not only want to solve the problem of the supply of electrical energy, but wish to be able to master the necessary technique of designing and constructing these new plants, anticipating a future in which they will have to construct and instal a great number of them in their own territory. For this reason they wish to train their technicians, acquire experience, know-how, technological knowledge, integrate their own industries, in order to reach in the near future a certain amount of autonomy and independence. " Only someone with a restricted outlook," Sir Claude asserted, " would fear the outcome of our reasonings and think our efforts pointless, and that we supply our competitors with arms with which to fight against us."

Long experience has shown that foreign industries in one way or another, even without our help, would reach their goal in any case ; if we refused to help them other industrial countries would very gladly take our place ; but if our work in assisting them technically is far-seeing and thorough the ties which are established with foreign industries are bound to last and eventually strengthen and, even if we have to give up the supply of that plant which is simpler and less specialised, we can always hope to exercise our influence by selling the more specialised and complex products, that is, the fruits of our researches and brains.

## INTERNATIONAL COMBUSTION LTD.—NEW EDUCATIONAL COLOUR FILM

A major problem in British industry today concerns the shortage of young skilled technologists. In view of this, their recruitment and training is becoming increasingly important to Britain's industrial future. This need was foreseen some years ago by International Combustion Ltd., and consideration was given even then as to how to stimulate the interest of young men in the prospects offered by the steam power generating industry. One of the measures taken by the company was to produce an educational sound film on the subject of combustion and the economical use of coal as a fuel for industry. This was presented in 1952, and such was its success that another film, in sound and colour, has now been introduced which covers the very important aspect of the power industry—the generation of steam.

The new film is entitled " Steam and Steam Generation," and sets out to describe in simple, easily-understood terms the properties of steam, as well as the application of these properties to the production of electrical power. It shows the manner in which steam is generated, and depicts scenes illustrating the elementary production of steam in a flask at the Royal Institution Laboratories, to its generation at the present day elevated pressures and temperatures for the operation of turbines in major power plant installations. A study is made of the techniques used in the design and construction of high capacity boilers, showing their development from the early " haystack " type to the largest units in use today, and includes a detailed examination of a scale model of one of the International Combustion boilers at Willington " A " power station. Animated diagrams are used to illustrate the striking comparison between the enormous outputs achieved by present-day designs, and those in operation a few years ago. The progress made in boiler design over the years is well illustrated by a description of one of the 1,400,000 lb./hr. boilers now being constructed by International Combustion Ltd. for High Marnham power station. This is believed to be the highest capacity boiler at present under construction anywhere. The film concludes by pointing out the way in which even the present assisted and forced-circulation twin-furnace designs will change again to meet super-critical conditions, and a glimpse is afforded of the design features of even higher capacity units planned for the future.

" Steam and Steam Generation," which has a running time of 31 min., is presented in Eastman Colour, making use of both actuality shots and animated diagrams to promote the interest of the subject. It was produced for International Combustion Ltd. by Film House Productions Ltd., with the co-operation of the Royal Institution and the Science Museum. The film will be employed extensively for educational purposes, and can be used as a foundation for further study. Copies (either 16 mm. or 35 mm.) are available free on loan to technical colleges, schools, and other interested organisations. Application should be made either to International Combustion Ltd., Nineteen, Woburn Place, W.C.1, or to Gaumont-British Scope Film Library, 11, Belgrave Road, S.W.1. We understand that, if preferred, arrangements can be made for free film shows to be given on the company's own equipment.

## EUROPE'S LARGEST TITANIUM MELTING PLANT

The largest titanium melting furnace in Europe was put into operation recently at the Kynoch Works of I.C.I. Metals Division at Witton, Birmingham. This is one of three furnaces supplied to I.C.I. Metals Division by W. C. Heraeus G.m.b.H. (Western Germany), for the production of double-melted ingots up to 4,200 lb. in weight, by the consumable electrode arc melting process. The furnaces were delivered in January, 1958, and the first 1-ton ingot was produced a little over two months later. Within a few days, an ingot weighing 4,200 lb. —the largest ever produced outside the U.S.—was successfully melted. The availability of such large ingots widens the scope of fabricating techniques which can be applied to titanium, and in particular, makes possible for the first time the rolling of slab into long-length coils by strip rolling techniques without the necessity for welding small coils together. It also increases yield by decreasing surface/volume ratio. Any reduction in process scrap is, of course, a most significant factor, because titanium is still a relatively expensive metal.

Other interesting features of the new equipment are that the melting current employed is higher than has ever before been used for this purpose in Europe, which facilitates more complete melting and results in ingots of improved homogeneity and better surface quality. The furnace will normally operate with a high degree of vacuum, a pressure of under 10 microns being maintained throughout a melt. Facilities are also provided for melting under a reduced pressure of an inert gas, should this be required. Particularly useful are features which reduce " down time " between melts and effect big improvements in furnace utilisation.

The hazards associated with titanium melting are now understood, and the new installation incorporates the most advanced methods to ensure safe working. All operations are carried out by remote control and the furnaces are installed in reinforced concrete cubicles affording complete protection. In the control room, optical systems give operators a clear view of the furnace interior throughout the melting process. Other instruments record essential technical data at all stages and incorporate a system of fault indication and location. The effect of such completely protective measures is to allow considerably greater flexibility in melting operations, itself an important advance in the technology of titanium melting.

It is less than three years since I.C.I. commissioned Britain's first titanium melting plant. In 1955, 18 furnaces were needed for an output of 1,500 tons a year ; today, three are sufficient to produce over 2,000 tons a year. This increased capacity, together with the availability of high-quality ingots in larger sizes, is likely to open up still further outlets for titanium, a metal already firmly established in the aircraft industry and now finding a rapidly expanding market in the construction of chemical plant.

# A 550-MW Turbo-generator Set

AS announced recently, the Central Electricity Generating Board is placing an order with C. A. Parsons & Co. Ltd. for a 550-MW turbo-generator, which will be the first of its kind, and the largest in the world. This follows the award of the contract for the 3,750,000 lb./hr. boiler to serve the set, to International Combustion Limited, as was recorded in the March issue of this journal. It is intended to install two such generating sets in the projected station at Thorpe Marsh, near Doncaster, and on a site which is within easy reach of a coalfield. This is necessary in view of the fact that the coal consumption of a boiler to steam such a set will be between 205 and 220 tons per hour, according to the quality.

It is interesting to recall the remarkable rate of increase in the capacity of turbo-generator sets installed in this country in the past ten years or so. The immediate post-war programmes were concentrated on standard sets of 30-MW and 60-MW rating. Later, the Central Electricity Authority placed orders for units of 100-MW to operate with steam conditions of 1,500 lb./sq. in., and 1,050 deg. F. The first of these sets have been installed at Castle Donington and Willington "A" power stations respectively. These machines were followed by others of 120-MW output with steam conditions of 1,500 lb./sq. in., 1,000 deg. F., and reheating to 1,000 deg. F. Such a machine is shown in Fig. 2 under construction at the C. A. Parsons works at Heaton for Kincardine power station.

By 1956, Parsons had received orders for machines of 200-MW output for installation in generating stations in England and Canada. The machines for England were ordered by the C.E.A. for installation in West Thurrock generating station; they will be single-line units driving a single hydrogen and liquid-cooled generator. The machines for Canada were ordered by the Hydro Electric Power Commission of Ontario, for the extensive Richard L. Hearn generating station, Toronto, where Parsons had previously installed four 100-MW hydrogen-cooled sets between the years 1951-3. The addition of four 200-MW machines will bring the installed capacity of the station to 1,200-MW making it the largest station in the world with machines made by one manufacturer. These 200-MW machines are of cross-compound design with the high-pressure lines of the turbine running at 3,600 r.p.m. and the low-pressure lines running at 1,800 r.p.m.—each line being coupled to a 100-MW hydrogen-cooled generator. Fig. 3 shows the i.p.-l.p. line erected at Heaton Works.

The turbines of the single line 200-MW units are of the four-cylinder type comprising an h.p., i.p. and two double flow l.p. cylinders, the steam conditions at the stop-valve being 2,350 lb./sq. in. pressure, 1,050 deg. F. temperature with reheating to 1,000 deg. F. The steam conditions for the cross-compound turbines are 1,800 lb./sq. in. pressure, 1,000 deg. F. temperature, with reheating to 1,000 deg. F. Last year orders were received for two machines of 300-MW output for a new generating station at Lakeview near Toronto, Canada. The turbines for these machines will be of cross-compound design taking steam at 2,350 lb./sq. in. pressure, 1,000 deg. F. temperature with reheating to 1,000 deg. F.

In the design of the generators for the 200-MW machines under construction for the C.E.A. the limitation in size for transportation becomes a major problem. Parsons, therefore, decided on water-cooling of the stator windings to allow for a greater output to be obtained from the generator for the same frame size and temperature rise. This system uses water-cooling of the stator windings. Permission was given by the C.E.A. to make a prototype winding for a 60-MW hydrogen-cooled generator which was to be installed in Tilbury generating station. This generator was erected and successfully tested at Heaton Works in November last year and commissioned in the early part of this year. The new design permits generators over 300-MW to be made within the transport limits. Such developments have made possible, today, the 550-MW Parsons turbo-generator. This turbo-generator will be a cross-compound unit consisting of two lines arranged in tandem, each line comprising four turbines driving a 275-MW hydrogen- and liquid-cooled generator. An illustration of a model of the complete machine is shown in Fig. 1.

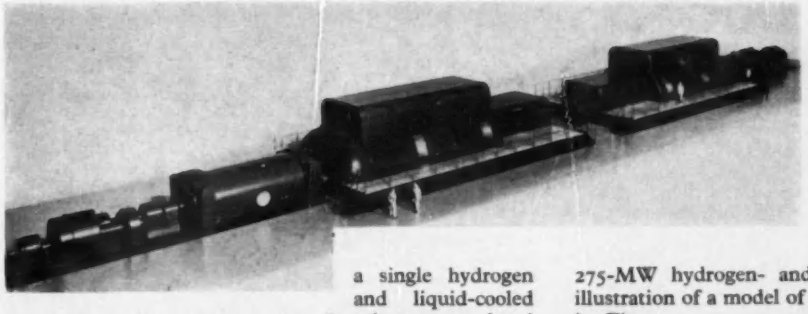


*Fig. 1. Model of 550-MW cross-compound turbo-generator, consisting of two lines in tandem, which is to be constructed by C. A. Parsons & Co. Ltd. for the Central Electricity Generating Board.*

All eight turbines are double-flow type with the high-pressure cylinder on the first line. From the exhaust of this cylinder the steam is reheated, and passed to the first intermediate-pressure cylinder on "B" line. On leaving this cylinder the steam divides equally between duplicate second intermediate-pressure cylinders, one on each line. Final expansion of the steam is then through two low-pressure cylinders on each line. A single-row velocity wheel is used in the initial stage of both the high-pressure turbine and the first intermediate-pressure turbine, reaction blading being used throughout

the remaining rows. Both the high-pressure cylinder and the first intermediate-pressure cylinder are of double-shell construction.

The machine will operate with steam at an initial pressure at the stop-valves of 2,300 lb./sq. in. and a temperature of 1,050 deg. F., reheating to 1,050 deg. F. Steam will be led to the turbine through two steam-chests arranged one on each side of the high-pressure cylinder.

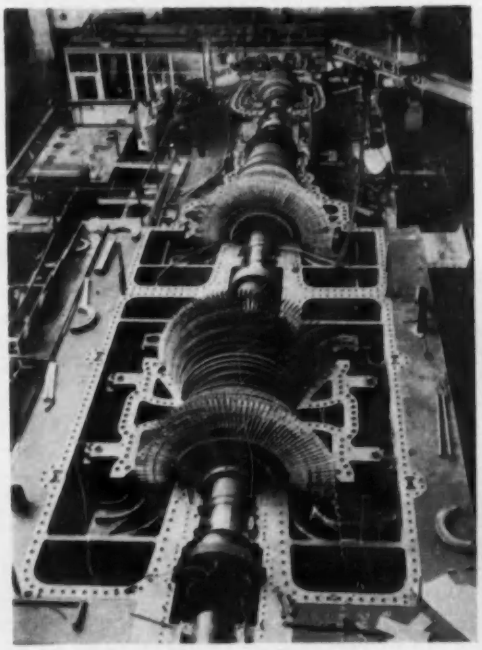
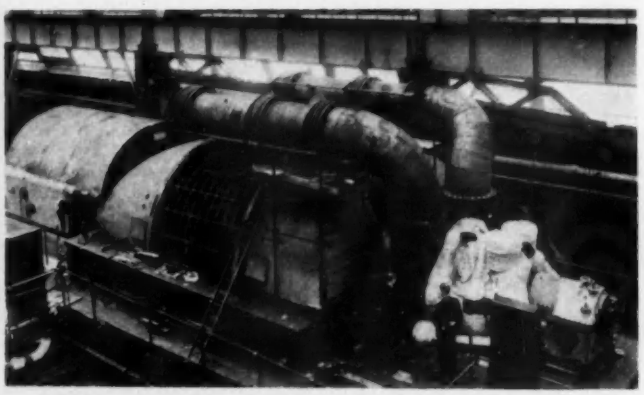


*Fig. 2. (left). One of the 120-MW turbines under construction at the Heaton Works of C. A. Parsons & Co. Ltd., for Kincardine power station of the South of Scotland Electricity Board. The complete station will have six of these 120-MW sets.*

*Fig. 3. (below). Parsons 200-MW cross-compound set being erected for testing at Heaton Works. This machine is one of four sets for the Richard L. Hearn power station, Toronto, of the Hydro-Electric Power Commission of Ontario.*



Each chest will be of forged construction, containing two runaway stop-valves and two governor valves. Because of the large storage capacity of the reheat system, it is necessary to prevent this steam flowing into the turbine when sudden loss of load occurs. Therefore, intercept and reheat emergency stop-valves are incorporated in the reheat system; release valves which simultaneously release this steam to the atmosphere act as an additional safeguard. The turbines will have two governors; the main speed control governor, driven from the high-pressure turbine shaft and an auxiliary governor driven from the first intermediate-pressure turbine shaft. One governor will be provided on each line of turbines and mounted on a cross shaft driven through a worm and wheel.

Arrangements will be made to extract steam from the turbine at seven pressure points in order to heat the condensate returning to the boiler, to a temperature of 486 deg. F.

To ensure uniform heating and cooling of the four turbine spindles and generator rotor on each line, when starting up or shutting down the machine, motor-driven rolling gears are to be provided. With these gears the machine can be kept slowly turning after being shut down, so that distortion due to unequal temperature distribution is avoided.

Steam from eight exhausts is to be dealt with by four condensers having a total cooling surface of 330,000 sq. ft. The generators will operate at 18-kV, 0.85 p.f., 50 c/s at the design speed of 3,000 r.p.m. The rotors are to be direct-gas-cooled type, operating in hydrogen at a pressure of 45 lb./sq. in. Each stator will have a direct-cooled winding, using demineralised water as the cooling medium circulating through the conductors, which will be built up of hollow rectangular copper tubes. Excitation for each generator is to be provided by a main and pilot exciter driven from the generator rotor shaft through reduction gearing. Ventilation of the exciters is effected by the circulation of air around a closed circuit by means of a blower mounted on the pinion of the gear drive to the main exciter shaft.

## NEW ATOMIC SAFETY COMMITTEE

**Sir Douglas Veale,** C.B.E., until recently Registrar at Oxford University, has accepted the chairmanship of a committee set up by the United Kingdom Atomic Energy Authority to advise on training in radiological protection. The committee includes: **Sir Ernest Rock Carling,** consultant adviser to the Ministry of Health, Atomic Energy Authority and the Home Office; **Professor W. V. Mayneord,** Director of Physics Department, Institute of Cancer Research, Royal Marsden Hospital; **Professor B. W. Windeyer,** Professor of Radiology (Therapeutic), University of London. This committee will advise the Authority on the training and provision of specialist health and safety staff, not only for the Authority's own purposes but also to meet the needs of the nation as a whole.

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## BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION

**Mr. Thomas Johnston,** C.H., L.L.D., J.P., F.E.I.S., chairman of the North of Scotland Hydro-Electric Board, has been appointed president of the British Electrical Development Association in succession to Viscount Chandos. **Lt. Col. E. H. E. Woodward,** C.B.E., M.C., T.D., B.Sc.(Eng.), M.I.E.E., has been appointed a vice-president of the Association. Col. Woodward was a member of the British Electricity Authority and the Central Electricity Authority until last December. **Mr. W. N. C. Clinch,** M.I.E.E., controller, Eastern Division, Central Electricity Generating Board, has been elected chairman of the E.D.A. Council, and **Mr. T. E. Daniel,** M.Eng., M.I.E.E., A.M.I.Mech.E., chairman, North Western Electricity Board, vice-chairman for the year 1958/59.

# RECENT Equipment AND Accessories

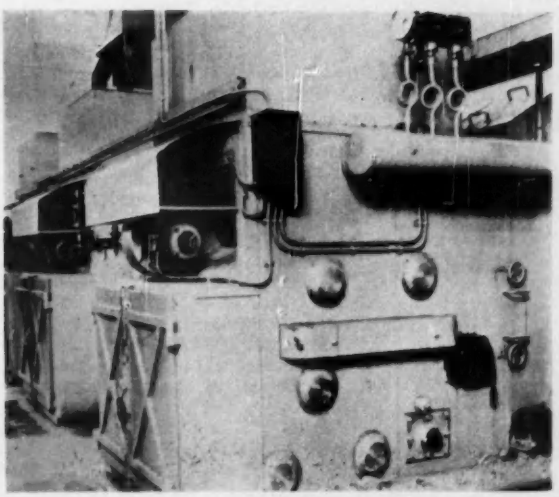
**Remote level controller**

J. Edward Hall (Elec. Engineers) Ltd. announce the addition to their existing range of level instruments of the new "Proxicon" Mark III dust and weatherproof industrial level-controller. This new capacitance-type unit has been designed to control the levels of any liquids or free-flowing solids without necessitating direct contact with the material. It has no moving parts in the container and incorporates a number of important advantages. These include the addition of tapped electrode terminals, whereby remote control can be extended up to 3,000 ft.; the incorporation of heavy-duty contactor-type double-pole change-over relay with "Elkonite" faced contacts, giving greatly improved contact life and increased flexibility in control circuit functions; and the provision of a "trigger" circuit by which "snap" operation is ensured even with a slow capacitance change, due to slow movement of material levels. The addition of a separate signal station unit, which incorporates the mains voltage signal lamps, formerly included in the main control unit, has eliminated the overheating problem and gives the advantage of unrestricted siting for easy visibility. Further, the company claim that sensitivities greater than 1.0 p.f. can be achieved under all conditions subject to variations of not more than ± 0.25 p.f. with mains variations of + 5 to − 7½ per cent. and not more than ± 1 p.f. with temperature variation of ± 20 deg. F. from a 68 deg. F. datum figure. Other features are independent enclosure of relays; the resilient mounting of valves and indicator lamps; the inclusion of H.R.C.-type cartridge fuses for relay circuits; the fitting of post type terminals with shell clamps for mains, relay and electrode wiring; and the provision of an electrode switch for simple selection of high- or low-level operations, with "fail to safe" feature in either condition of working. Finally, the set point is stiuated in an accessible position and can be easily adjusted on site; and quick and easy removal of chassis offers greatly improved servicing facilities. The "Proxicon" can be supplied for single and dual level applications. (*J. Edward Hall [Elec. Engineers] Ltd., Clarence Road Works, Leeds*, 10.)

*(Left). The new "Proxicon" Mark III industrial remote level controller for single level applications. [J. Edward Hall (Elec. Engineers) Ltd.]*

**A coke-fired hot water boiler**

Newton Chambers & Co. Ltd. have entered into arrangements with Bronswerk N.V. of Holland for the manufacture and installation in the United Kingdom, of the Redfyre Emma, a coke-fired boiler used extensively on the Continent in connection with central heating and hot water supplies. These installations have ranged from a single unit of 250,000 B.Th.U./hr. to multiple units of, for example, four boilers providing a total output of 30 million B.Th.U./hr. A special feature of the boiler is that it incorporates a secondary combustion chamber, and is in effect a gas-producer as well as a boiler. This, it is claimed, ensures a thermal efficiency of between 85-90 per cent., with a resultant saving in fuel costs. The coke is gravity fed into the furnace through which primary air is passed, the gas produced passing to a combustion chamber into which preheated secondary air is admitted, ensuring complete combustion. From there, the products of combustion pass through a heat-exchanger on their way to the chimney. Automatic temperature control is provided, and the boiler can be raised from low-load to full-load in a very short time. A mechanical clinkering device incorporated is simple to operate, being manipulated by a lever at the side of the furnace. The boiler requires little attention, and, according to the manufacturers, will operate for eight hours under full-load conditions and up to 48 hours on low-load, without supervision. It is very compact, takes up little space and can be sited at ground level or in a basement. It can be used with varying types of mechanical coke-handling appliances or may be charged manually. The "Emma" boiler will burn coke in a variety of sizes including sizes up to 4-in. (*Newton Chambers & Co. Ltd., Thorncliffe, Sheffield.*)



*(Right). An installation of Redfyre Emma coke-fired boilers. (Newton, Chambers & Co. Ltd.)*

**Smoke control equipment**

Photoelectronics (M.O.M.) Ltd., have recently announced the introduction of smoke control equipment incorporating a new cadmium photo-electric cell which is claimed to be more powerful than conventional

types—a fact which enables the valve amplifier to be omitted from the unit. This in turn enables the equipment to be of a more simple design and contained in a smaller housing. Two units are available at the present time. The smoke alarm type-CCSA suitable for chimneys up to 15-ft. in diam. complies with B.S.S.2740 : 1956. A light beam projector unit throws a beam of light across the chimney on to the cadmium photoelectric cell housed in a receiver unit. The cell converts the light into electrical energy and as smoke breaks the light beam a varying current is emitted. This current is sufficient to operate a relay direct, and when the smoke has reduced the current emitted by the cell to a point set by the operator the relay closes and the alarm is given. The smoke density indicator type-CCSI complies with B.S.S. 2811 : 1957 and is suitable for chimneys up to 40-ft. diam. Operating on the same principle as the smoke alarm the varying current emitted by the photoelectric cell is shown on a 10-in. scale meter calibrated in percentage obscuration. Visual and audible alarms are also incorporated and the company say a variety of recorders can be supplied to give a permanent record of combustion conditions. [*Photoelectronics (M.O.M.) Ltd., Fotron Works, 63A, Kingston Road, London, S.W.19.*]

**A unit dust-collector**

A new unit dust-collector, known as the "Bahco," and which employs a method of water-washing, has recently been introduced by Prat-Daniel (Stanmore) Ltd. The inlet branch on entering the body of the washer is immersed in a water bath so that the dust-laden air and water are sucked up by the vortex formed by the cyclone. The water is vaporised, and a washing action is obtained with large quantities of water droplets travelling at high speed and turbulence. This ensures complete and thorough wetting of the dust, and an eliminator plate on the outlet of the cyclone returns the water and wetted dust to the water bath. The clean air continues upwards and passes through a metal filter which removes any last traces of water and dust. The clean and dry air can then be recirculated. The collected dust can be easily discharged in the form of a sludge and a valve at the bottom of the tank is provided for this purpose. The centre of the cyclone unit is made of stainless steel and other parts in contact with the water are protected from corrosion by special anti-corrosive paint. The wet cyclone is simple and inexpensive to install. It is easily moved to any position and can, if necessary, be wheeled away to a convenient place for the sludge to be emptied. The main overall dimensions of the "Bahco" are 1-ft. 10-in. diam. by 4-ft. 1½-in. high. Three capacities are available, namely 265, 295 and 330 cu. ft./min. of air, the respective power requirements being 0.56, 0.60 and 0.66 h.p. [*Prat-Daniel (Stanmore) Ltd., Whitecroft, Nailsworth, Stroud, Glos.*]

**pH Meter test set**

The Lock Universal pH meter test set is a new instrument for quickly checking and localising faults on pH meters, and on pH electrode systems and for assisting in the checking and setting up of industrial pH measuring, recording and control gear. The set consists basically of a long-life dry-cell across which is connected a number of high-stability resistors forming a potentiometer. These resistors connect to a multi-position selector switch which selects an increasing number of millivolts as it is rotated in a clockwise direction, each step being approximately 2 pH units. A number of interconnecting leads are provided for connecting to the pH meter under test. Two output connections to the pH meter are provided, one low impedance, and one high impedance of approximately 250 megohms to simulate the high-resistance of normal glass electrodes. The manufacturers say that no electrical knowledge is required to make full use of this instrument. (*A. M. Lock & Co. Ltd., Prudential Buildings, 79, Union Street, Oldham, Lancashire.*)

**New double reduction unit**

The latest addition to the range of David Brown worm gear units is the new size 2½ "Radicon" double reduction worm reducer. Designed for low-powered, slow moving drives, this unit provides a choice of 53 ratios between 65 : 1 and 3,600 : 1, with a correspondingly wide range of output torques between 1,270 and 3,300 lb./in. at input speeds from 500 to 3,000 r.p.m. Standard ratios of the 1⅝ and 2¼ single reduction units are combined to give this extensive range of ratios, and a further feature is the use of the single reduction unit gears with the exception of the second reduction worm-shaft. Detachable feet are fitted, and alternative facings provided so that the unit can be mounted in a number of different operating positions. Special case-hardened steel is used in the manufacture of the worms which are precision ground after hardening, and the centrifugally-cast bronze wormwheels are pressed and keyed to the intermediate and low speed shafts. Dual purpose bearings are fitted throughout. The cast-iron case is dust-proof and oil-tight. Cooling is by natural convection, and the gears and bearings are splash lubricated. (*David Brown Industries Ltd., London Gear Division, Stonebridge Park Works, London, N.W.10.*)

**Streamlined heavy-duty fractional h.p. motors**

Crompton Parkinson Ltd. have recently introduced a new range of fractional h.p. motors—the series "T"—which are more streamlined and compact than previous models, and incorporate several design improvements. Symmetrical ventilation by means of twin fans which draw in air around the bearings and dispel it through holes in the lower part of the shell, causes the temperature rise of many ratings to be well below the permitted maximum. The long-life centrifugal gear and open circuit switch in the new machines is claimed to function quietly within close speed tolerances irrespective of the load inertia. A compact and spill-proof oil well carries a larger amount of oil than was the case with previous motors of similar rating, and this is supplied with sufficient oil for two years running at normal ambient temperatures and hours of operating. The bearings of the series "T" motor have been developed from the "Marathon" Mark III bearings, and although the motor is only available with sleeve bearings at the present time, a ball bearing version will, we understand, be available shortly. (*Crompton Parkinson Ltd., Crompton House, Aldwych, London, W.C.2.*)

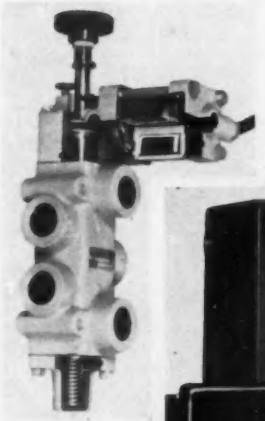
**Acid pickling of castings**

To provide facilities for the acid pickling of steel castings of a wide variety and weight, David Brown Industries Ltd., Foundries Division, have designed and installed tanks capable of holding the largest of their products, which it is anticipated will be half turbine casings, weighing up to 8-tons, for which orders are currently on hand for conventional and atomic power stations. Employed in conjunction with hand fettling, pickling of castings in hydrochloric or sulphuric acid ensures that all foreign matter is removed from the metal. Two identical tanks have been built together with a neutralising sump. A two-way reversible pump serves both tanks and is capable of effecting complete transfer of the liquid in five minutes. After lowering the casting (or castings) into the empty tank, the slinging chains are removed, and acid is then transferred from the other tank. The acid solution (about 10 per cent. strength) is

maintained at a temperature of about 60 deg. C., at which heat, pickling proceeds for about two hours. By loading the second tank in the meantime a continuous flow of work is ensured. Only very infrequently is it necessary to dispose of the acid, this being effected after a neutralising lime solution has been added. (*David Brown Industries, Foundries Division, Penistone.*)

**Solenoid valve with overriding manual control**

To meet the demand for a solenoid-operated fluid power control valve which can be actuated when the electrical supply is not available,

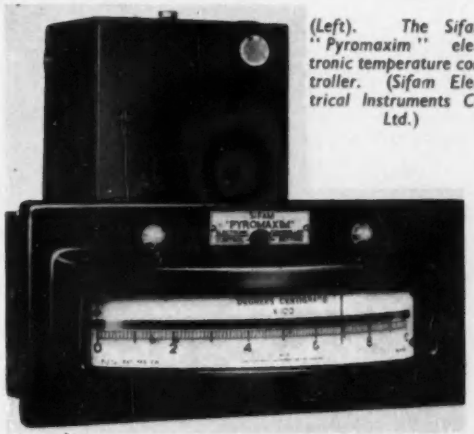


*(Above). A standard ½-in. bore, 4-way solenoid-operated control valve, with overriding manual control and lock. (Baldwin Instrument Co. Ltd.)*

Baldwin Instrument Co. Ltd. have introduced a novel mechanism which permits such a valve to be manually-operated. The operation is by means of a shaft which enters through the end cover of the valve and makes contact with the pilot piston head, which in turn is connected to the spool. When the over-ride shaft is depressed, it moves the spool from the "normal" to the "operated" position. The spool can be locked into the operated position by rotating the over-ride shaft when it is fully depressed, whereupon a "D" shaped collar on the shaft locates behind the head of a locking screw. The locking position is positively indexed which ensures that the mechanism remains firm in the event of vibration. In order to prevent the knob, used for depressing the shaft, from moving in and out with the normal operation of the spool, the shaft is not actually fixed to the spool, but only rests against it. At present, the over-ride feature is available as standard on the company's ¼-in. and ½-in. bore control valves only. In addition to being used on solenoid valves, it can also be used on pilot-operated valves. (*Baldwin Instrument Co. Ltd., Brooklands Works, Dartford, Kent.*)

**An electronic temperature controller**

The Sifam "Pyromaxim" electronic temperature controller now generally available has a mirror scale of more than 8-in. length which ensures legibility and accurate reading. Calibration complies with B.S.S.1041 recommendations and the control response is claimed to be within ¼ per cent. The measuring galvanometer incorporated employs a powerful Alcomax magnet surrounding a moving system which swings between spring-mounted sapphires; automatic cold junction compensation being




*(Left). The Sifam "Pyromaxim" electronic temperature controller. (Sifam Electrical Instruments Co. Ltd.)*

provided as standard. This movement and its pointer are completely free of mechanical stress or interference. A simple electronic circuit provides the link between measurement and control which instantaneously operates an enclosed relay rated at 3-A and 250-V a.c. non-inductive load. A feature of the unit is the plug-in arrangement of the electronic amplifier which can be removed and replaced in a few minutes, thus facilitating installation and maintenance. The "Pyromaxim" is available in ranges from 0-200 deg. C. to 0-1,600 deg. C. Calibration can be made for any type or thermocouple. The controller is supplied for either flush or wall-bracket mounting, for use with supply voltages of 110/220/240 a.c. (*Sifam Electrical Instruments Co. Ltd., Leigh Court, Hr. Lincombe Road, Torquay, Devon.*)

**Electrodes for gouging and piercing**

The English Electric Co. has introduced a new type of electrode, designed for cutting grooves, gouging, piercing or removing surplus metal, and which is claimed to be equally effective on all steels, cast-iron and non-ferrous metals. These electrodes, known as "Groovees," can be used with ordinary a.c. or d.c. welding plant without additional equipment such as oxygen or air supplies. For cutting grooves, the electrode is held at an angle to the work surface, pointing in the direction of travel. After an arc is struck, the electrode is moved rapidly along the line to be gouged. The force of the arc cuts the groove and removes the molten metal giving a clean bright finish. For gouging out defects in castings a series of overlapping grooves are cut in alternate directions making it possible to remove a defect of considerable depth. When piercing holes or removing rivets, the electrode is held perpendicular to the work-piece, the arc struck and held until the metal flows, and then the electrode moved into the molten pool. With manipulation, holes up to ¾-in. diam. can be pierced in plate up to ¼-in. thick, and rivets removed from much thicker plate. (*The English Electric Co. Ltd., Welding Electrode Division, Clayton-le-Moors, Accrington.*)

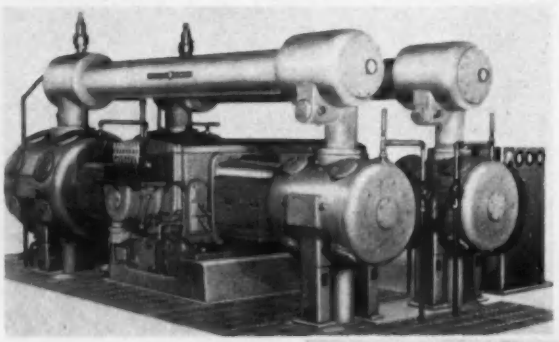
**Vertical high-frequency motor-alternator set**

The British Thomson-Houston Co. have announced a new type of vertical, medium rating (75-300-kW) high-frequency generating equipment for induction heating and melting applications at a frequency of 8.7 kc/s. The new set, being arranged for vertical operation, occupies far less space than a normal horizontal machine of the same rating, and furthermore the company claim that it is very quiet in operation. The first set to be manufactured had an output of 75-kW, 8.7 kc/s, and comprised a heteropolar inductor alternator and a squirrel-cage induction motor—the motor being mounted vertically above the alternator. The frame and the shaft are mounted on the bottom end-shield and the set is supported on four resilient mountings. It is totally enclosed inside sheet metal covers, which can easily be removed, and is cooled by two water-coolers, one being placed in the alternator stator core and the other wound spirally round the motor frame. The company point out that they can also offer a similar vertical set of a higher rating, and sets will shortly be available at 3 kc/s and 8.7 kc/s with approximately

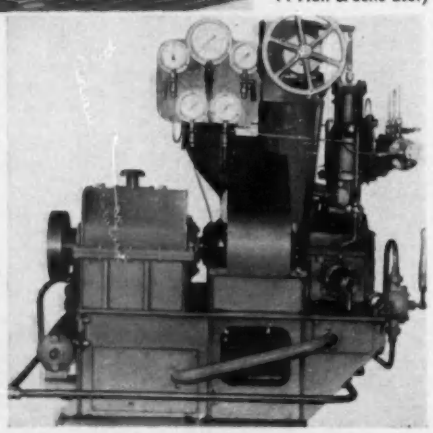
double the output of the present machine. Under suitable conditions, these high-frequency alternators may be operated in parallel to supply higher powers than can be generated by a single unit. (*The British Thomson-Houston Co. Ltd., Rugby.*)

**Balanced opposed compressors**

A new range of heavy-duty compressors embodying balanced opposed design has been introduced by the Consolidated Pneumatic Tool Company. Known as the Class FE, the new range meets a demand for outputs up to 5,000 cu. ft./min. at low pressures and lesser outputs up to 3,000 lb./sq. in. For normal shop use at 100 r.p.m., compressors with outputs from 1,500 cu. ft./min. to 4,000 cu. ft./min. can be supplied. Advantages claimed for the FE class of compressor are high efficiency, small floor area and foundations required, easy accessibility and vibration reduced to a minimum by dynamic balancing. The dynamic balance has been achieved by placing cylinders with equal reciprocating weights on opposite sides of a frame with pistons driven by a double-throw crankshaft and cranks 180 deg. apart. Cranks are arranged in pairs on the shaft and each pair is placed between two main bearings. This reduces the piston offset required and holds the magnitude of the couple to a minimum. Advantages arising from this arrangement, other than elimination of all inertia shaking forces, are said to include a greatly reduced load on the main bearings, the piston loads produced by the air or gas pressure in each cylinder being offset by each other. Salient construction features include a fully-stress-relieved crankcase frame, large crankcase access openings with light-weight aluminium covers and individually cast Meehanite crosshead guide housings. Full force-feed lubrication to the bearings, crosshead pin and guides is maintained at a pressure of 40 lb./sq. in. by a positive-displacement rotary-type pump driven from the end of the crankshaft through a flexible coupling and spiral gears. A hand-operated lubrication oil pump for flooding the bearings before starting up is also provided. A separate mechanical lubrication system feeds a controlled oil-supply to the cylinder and piston-rod packing. (*Consolidated Pneumatic Tool Co. Ltd.*, 232, *Dawes Road, London, S.W.6.*)



*(Left). The new Class FE compressor Model FE-42 with a capacity of 3,000 cu. ft./min. at 100 lb./sq. in. (Consolidated Pneumatic Tool Co. Ltd.)*



*A model from the new range of small, high-speed, geared steam turbines. (J. P. Hall & Sons Ltd.)*

**A small, high-speed, steam turbine**

A new range of small, high-speed, geared steam turbines, rated from 200 to 1,000 h.p., are now manufactured by J. P. Hall & Sons Ltd. Produced initially for driving centrifugal cargo pumps in oil tankers, these are reliable and robust. The basic turbine remains unchanged throughout the range, with only detail difference to suit particular working conditions. Thus, new nozzles and throttle valve seats can be supplied to adapt existing turbines, the fitting of these items being easily carried out. The turbines are of the velocity compounded impulse type, mounted on a rigid combined frame and gearbox. All the latest techniques are incorporated, including, for example, the use of standard steel-backed white-metal journal bearings for the rotor and pinion shaft, and gear shaft. These can be removed without lifting out the shaft, and replacements can be inserted without the need for any scraping or hand fitting. A hydraulic constant speed governing system, with manual speed variation control, hand trip control at the turbine, forced-lubrication with oil circulation indicators, full-flow oil filter, oil cooler, overspeed trip device, relief valve, tachometer, pressure gauges, etc., form part of the standard equipment. Optional extra fittings include remote hydraulic speed variation control ; remote reading tachometer ; remote hydraulic relay hand trip control ; low lubrication oil pressure trip ; high exhaust back-pressure trip, etc. (*J. P. Hall & Co. Ltd., Peterborough.*)

**A modern galvanising plant**

A new Birlec Ltd. galvanising line installed at the Ebbw Vale works of Richard Thomas and Baldwins Ltd. is capable of producing 10-tons of either galvanised sheet or coil per hour. This modern plant is nearly 700-ft. in length, 36-ft. wide, and 30-ft. high, and can accommodate strip up to 48-in. in width. Driven by a roller conveyor at speeds of up to 250-ft. per min. through all the stages of cleaning, heat-treatment, pickling, coating, shearing to size, and inspection, the strip is processed in one continuous operation. Apart from electrical and mechanical maintenance staff, only six men per shift are required to control the equipment. The strip is cleaned during its passage through a gas-fired flame-heated furnace, after which its temperature is further raised to 1,550 deg. F. in the heating section of a reducing furnace by gas-fired radiant tubes. In the following section, which is electrically heated, the strip is maintained at a constant temperature where surface oxide is reduced, and annealing takes place. Entering a controlled cooling section it passes into the galvanising bath at a temperature of 950-1,100 deg. F., depending on the requirements of the bath. Electric heating elements are provided for initial melting of the bath, and boosting during topping up. The strip emerges with a coating which has an adherence sufficient to withstand drawing and forming operations up to the limit of the steel base, and represents a radical departure from earlier methods of sheet steel galvanising. Throughout the line, from entering the reducing furnace to emerging from the zinc bath, a protective atmosphere o

dissociated ammonia is supplied to all chambers by a Birlec ammonia cracking plant. The total electrical rating of the installation is approximately 1,000-kW plus 50-kW for each of the two ammonia dissociators. Coke-oven gas with a gross calorific value of 500 B.Th.U./cu. ft. is used for the gas-fired sections, the flame heater taking 18,000 cu. ft./hr. and the reducing furnace 21,000 cu. ft./hr. Honeywell-Brown Ltd. gas and temperature control equipment is provided. (*Birlec Ltd., Tyburn Road, Erdington, Birmingham, 24.*)

**Internal grooving tool**

A new grooving tool, the use of which does not require skilled operators, has recently been introduced by Geo. Salter & Co. Ltd. Known as the Salter "Truarc" it can be used for cutting grooves in bores, concentric to the bore diameter, to very close tolerances. It can be operated efficiently in standard drilling machines, capstans, centre-lathes, automatic machines or milling machines, and in a portable drill. The tool will operate either when it is rotating and the workpiece is static, or vice versa. It is most commonly used, however, with a drilling machine, and as the spindle of the machine is lowered into the job the bush in the gauge head—or bottom adapter, as the case may be—pilots into the bore to locate the cutter in its position to begin cutting the required groove. Continuing the downward pressure of the machine spindle causes the cutter to move from its neutral position, in an eccentric movement, until the required depth of groove is attained. When this depth is reached, the machine spindle will not move any further, even though downward pressure is still being applied. It is important to note that this "stop" action is within the tool itself and that no secondary stops are necessary no matter what type of operating machine is used. As the pressure on the spindle is relieved the cutter returns to its neutral position, and the tool is then withdrawn from the bore of the part now grooved. The standard tool is available in five sizes from ¾-in. to 4-in. bore diameters (*Geo. Salter & Co. Ltd., West Bromwich.*)

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**Albright & Wilson Ltd.** have introduced a new and simple testing kit that enables control tests to be made easily and quickly on different types of water. The results obtained using this kit are claimed to be adequate for the great majority of water-treatment control purposes, although slightly less accurate than those obtainable under closely controlled laboratory conditions. The new kit can be used for the control of water-treatment for steam boilers, including those where phosphate conditioning is employed, as well as for checking water-softener efficiency, and testing water in re-circulated cooling-systems. Raw and softened waters can be tested for total hardness, alkalinity to phenolphthalein and methyl orange, and chloride concentration. Boiler feed-water tests include total and caustic alkalinity, chloride and phosphate concentrations. Phosphate conditioning in order to prevent scale in boilers depends for its success on the maintenance of an adequate caustic alkalinity and reserve of phosphate in the boiler feed-water. Such conditioning is being increasingly used at low pressures, and is indispensable at high pressure. With this new kit, boiler feed-water testing can be carried out regularly and efficiently by boiler house personnel. In a lightweight transparent plastic case, the kit includes all necessary apparatus, together with polythene bottles containing reagents. The kit, complete with apparatus, an initial supply of reagents and full instructions for use, costs only £12. Further information regarding the kit and advice on water treatment problems can be obtained from Albright & Wilson (Mfg.) Ltd., 1, Knightsbridge Green, London, S.W.1.

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**Gilmoor Control Systems Limited,** manufacturers of supervisory controls and telemetering systems, has moved from Watford to the main building of Electroflo Meters Co. Ltd. (member of Elliott-Automation Ltd.), Abbey Road, Park Royal, N.W.10. The Electroflo Company has acquired the whole of the share capital of Gilmoor Control Systems Limited, the new address of which is now at Park Royal as above.

A new instrument company, **Research & Control Instruments Ltd.,** Instruments House, 207, King's Cross Road, London, W.C.1 (telephone No.: Terminus 8444), commenced operations on May 1st, 1958, and became the sole distributors in the United Kingdom for the electronic instruments and scientific equipment hitherto marketed by Philips Electrical Ltd. (Research & Control Instruments Division). The new company assumes full responsibility for the maintenance of existing Philips equipment and its field staff will be supported from a new service department and stores located at 49, Temperley Road, Balham, London, S.W.12 (telephone No.: Battersea 9166 and 9197). It will, in addition, become the distributors in Great Britain for the industrial X-ray equipment manufactured by C. H. F. Muller, A.G., Hamburg, and for Norelco (U.S.A.) X-ray diffraction and spectrographic equipment. Research & Control Instruments Ltd. have also been appointed sole distributors responsible for the sale and servicing of Mullard electronic measuring instruments and electro-chemical apparatus in the United Kingdom, fully supported by the manufacturers, Mullard Equipment Ltd. Mr. R. H. Cooke, who has been appointed a director and general manager of the new company, is well known in instrument circles, and he played a prominent part in organising the British exhibit at the first "Atoms for Peace" Conference in Geneva. He serves on the committee of the Nucleonics section of the Scientific Instrument Manufacturers' Association (SIMA).

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Publication No. S.91 entitled "Series 361 Recorders and Recording Control Stations" is available from **Electroflo Meters Co. Ltd.,** Abbey Road, Park Royal, N.W.10. The publication gives technical data on the construction of the instrument with reference to the 22 model numbers which are available in this new addition to the Electroflo range of automatic process control equipment.

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**Mr. H. W. Fender** has been elected chairman of the British Chemical Plant Manufacturers Association.

**Simon-Carves Ltd.** have been given the design and construction of the electro-precipitation plant for the first boiler unit to be constructed at the proposed Thorpe Marsh power station in the Yorkshire Division of the Central Electricity Generating Board. As mentioned in the March issue of this journal, the boiler will have a capacity of 3¼ million lb./hr. of steam, and it will serve a 550-MW turbo-generating set. The precipitator gas volume will be 1,540,000 cu. ft./min. This is believed to be the heaviest duty yet proposed for precipitators on a single boiler unit anywhere in the world. The boiler unit, which will be supplied by International Combustion Ltd., will consume about 210 tons of pulverised fuel per hour, and the flue gases will be cleaned by an installation consisting of pre-collectors for the removal of the coarser dust followed by electro-precipitators for the collection of the remaining fine dust particles. The combined guaranteed efficiency will be 99.3 per cent. Under average conditions, dust will be removed by the precipitator at a rate of about 12 tons/hr., and the chimney emission will be considerably less than 0.1 grain per cu. ft. The cost of the complete dust-cleaning plant will be in the region of £500,000.

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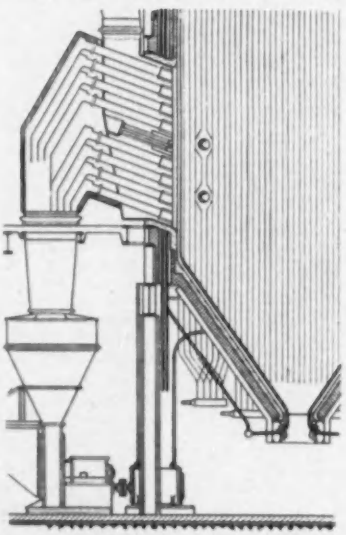
The first order for a television nuclear reactor camera has been placed with **Pye Ltd.** It will be used at the Central Electricity Generating Board's Bradwell atomic power station. The camera will be provided to help engineers to inspect the interior of the station's two reactors when they come into operation during 1960. The first of the three Pye TV cameras for exclusive use in the atomic energy industry was put into operation at Calder Hall in 1956. It was 3-in. diameter and 40-in. long, and had its own source of illumination. A special cooling system was also provided. The second camera, which was designed hurriedly for a special purpose in 1957, led to the development of a camera which incorporates facilities for handling objects within the reactor core. It is a camera similar to the latter, which is to be delivered to the Central Electricity Board sometime next year.

# OVERSEAS Steam Engineering Practice

*Abridgments of recent articles in the colonial and foreign technical press, concerning design and progress in the technique of steam generation and power plant equipment*

**Large brown-coal-fired German boilers**

The favourable operating results obtained with a brown-coal-fired boiler of 800,000 lb./hr. evaporation in which the burners are located in the front wall of the furnace, have furnished valuable data for comparison with a corner-fired boiler of exactly similar design. It appears that front wall firing will gain in favour, and a burner arrangement which has recently been introduced



is shown in Fig. 1. This shows a partial view of the furnace of a boiler unit rated at 836,000 lb./hr. In the case of very large units, which may range up to 1,760,000 lb./hr., corner firing will probably have to be ruled out. The good results obtained with a 1,000,000 lb./hr. unit with the burners in the furnace arch may, however, offer a solution, and it is possible that this burner arrangement will prove especially useful in the case of Benson boilers. Another proposal is shown in Fig. 2 which refers to a unit of 1,700,000 lb./hr. evaporation at 2,630 lb./sq. in. pressure and 987 deg. F. steam temperature. This boiler is designed for firing from two furnace sides, the fuel being Rhenish brown coal, and consists of two symmetrical halves of which one contains the live steam superheater and the other the reheater. This makes it possible to start the boiler with by-passing of the reheater. (*BWK, April*, 1958, *pp.* 164-166.)

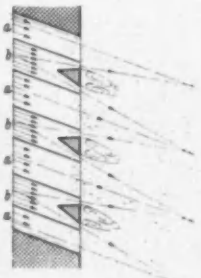


*Fig. 1. Mixing of pulverised fuel and air in front burners of a 800,000 lb./hr. boiler.*
*Key:—*
*(a) coal*
*(b) air*

**Australian atomic energy symposium**

Australia will welcome some 30 overseas scientists to a symposium on the peaceful uses of atomic energy, to be held in Sydney from June 2nd to the 6th, 1958. They will discuss with Australian technologists the part which atomic power could play in the development of Australia. More than 100 papers will be presented covering uranium exploration and production, uses of radio-active isotopes, atomic-reactor development and operation, fuel preparation and processing, economic studies, and fundamental nuclear research. The symposium is being organised by the Australian Atomic Energy Commission, with the support of the professional scientific and engineering institutions, industrial firms, power supply undertakings, and Commonwealth and State Governments. The U.K. Atomic Energy Authority will be represented by Mr. H. H. Gott, chief engineer (Industrial Liaison), Risley; Dr. H. M. Finniston, chief metallurgist, Harwell; and Mr. F. W. Fenning, group leader, Thermal Reactors, Harwell. British engineering contractors in the atomic-power field will send Dr. T. E. Allibone, director of research laboratory, A.E.I.; Mr. A. L. Shaw, export projects engineer, AEI-John Thompson Nuclear Energy Co. Ltd.; Mr. R. D. Vaughan, chief engineer, Nuclear Plant Co.; Mr. P. H. W. Wolff, chief engineer, English Electric Co. Ltd.; Dr. K. J. Wootton, assistant manager, GEC-Simon Carves Atomic Energy Group; and Mr. W. R. Wootton, department manager,

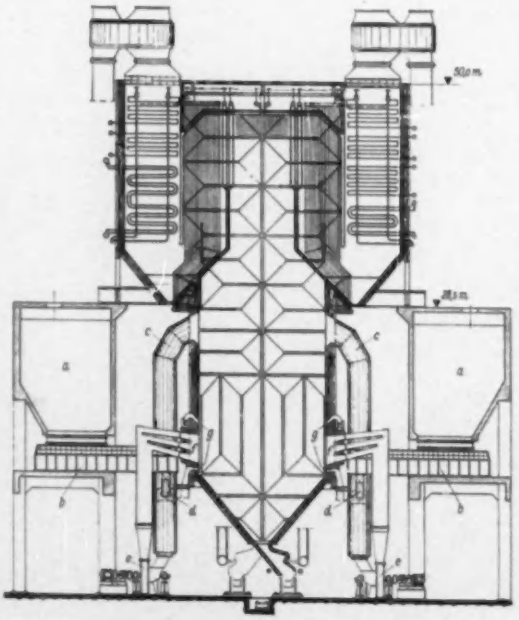


*Fig. 2. Radiant-type forced-flow, once-through flow boiler rated at 1,700,000 lb./hr. at 2,630 lb./sq. in. and 987 deg. F. Key:—(a) coal bunker, (b) coal distribution, (c) flue-gas recirculation, (d) coal admission, (e) pulverising mills, (f) burners, (g) secondary air.*

atomic energy department, Babcock & Wilcox Ltd. The U.S.A. Government will be sending Mr. L. C. Vogel, assistant director of operations, division of international affairs, Atomic Energy Commission (Legal and Administrative Aspects); Mr. L. H. Roddis, Jr., deputy director, division of reactor development, USAEC (Development of Nuclear Power); and six other representatives. The representative of U.S. industry will be Mr. A. Kramish, nuclear energy division, Rand Corporation. New Zealand is sending a large contingent, comprising Mr. T. Hagyard, senior lecturer in chemical engineering, Canterbury University; Dr. D. Hall, senior lecturer in chemistry, University of Auckland; Mr. J. F. McCahon, physicist, Dominion X-ray and radium laboratory; and Prof. S. R. Siemon, professor of chemical engineering, Canterbury University. The Canadian representative will be Dr. D. G. Hurst, assistant director, reactor research and development division, Atomic Energy of Canada Ltd.

**Gas-turbine power-station at Varberg**

A 10-MW gas-turbine power station at Varberg, on the west coast of Sweden, is intended to meet the requirements for peak, and emergency power at the already existing steam power station. The turbine together with its ancilliary equipment was supplied by STAL and ASEA. The unit can be started from cold and connected to the supply network in less than 5 min. The gas turbine includes a compressor with a low-pressure section and a high-pressure section, which rotate at different speeds independently of each other. The compressed air is heated in the combustion chamber which has seven flame-tubes into which oil is injected. The hot air then goes to a single-stage high-pressure turbine which drives the high-pressure compressor, and to a double-stage low-pressure turbine which drives the low-pressure compressor. The triple-stage power turbine is connected to the generator by means of a special coupling. The generator associated with the turbine is a normal turbo-generator for 12,500-kVA, 0.8 p.f., 6,600-V, 3,000 r.p.m., with a 70-kW directly-connected exciter. The generator and the exciter are cooled by means of circulating air. The control system incorporated consists of ASEA electro-hydraulic control gear. This regulates the supply of fuel to the gas turbine in accordance with the output or frequency desired, and contains, in addition, equipment for the automatic supervision of the maximum permitted turbine temperature and compressor pressure. Tests have shown that the efficiency of the gas-turbine power station at full-load (10-MW at an outdoor air temperature of + 5 deg. C., 760 mm. Hg.) is 26.5 per cent. The installation at Varberg is the first stationary gas-turbine power station in Scandinavia and the first one in the world to operate completely automatically. It is the largest gas-turbine generator built by STAL so far, but will be exceeded by the 40-MW unit now under construction. (*ASEA Journal*, Vol. 30, No. 11-12, p. 164.)

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The board of directors of the **National Industrial Fuel Efficiency Service** has made the following staff changes and appointments regarding N.I.F.E.S. area engineers. **Mr. C. A. Plummer,** M.Sc., A.R.I.C., M.Inst.F., 6, Harborne Road, Edgbaston, Birmingham 15, Midland Area. **Mr. K. Higginson,** B.Sc., M.Inst.F., St. Paul's House, 20-22, St. Paul's St., Leeds, 1, North Eastern Area. **Mr. R. Clare,** B.Sc., M.Inst.F., 89, Oxford Street, Manchester, 1, North Western Area. **Mr. L. F. Linnett,** B.Sc., M.Inst.F., 20, Alfred Street, Belfast, Northern Ireland, and **Mr. W. Short,** B.Sc., M.Inst.F., Baltic House, Mountstuart Square, Cardiff, area engineer in charge, Wales. The board has also appointed **Mr. George Gill,** formerly area engineer in the North Western Area, and **Mr. A. H. Pinder,** formerly area engineer in the Midland Area, as group managers in the northern and southern sections of the United Kingdom respectively. They will be responsible for co-ordinating the work of the four areas in each of their groups, and facilitating the liaison between N.I.F.E.S. area engineers.

* * *

**The Consolidated Pneumatic Tool Company,** 232, Dawes Road, London, S.W.6, have issued a new brochure dealing with their range of pneumatic hoists and rams. This 24-page brochure gives details of pendant hoists, horizontal bench and wall rams, vertical inverted and table top rams, cushioned and pivoted rams and numerous fittings such as trolleys for pendant hoists and mounting brackets and trunnion mounting for rams. Sections also deal with the company's range of multi-purchase hoists, pneumatic bench vices, operating valves, light type cylinders. In addition there are notes on service spares, whilst a final page is given to lubricating instructions.

As part of the policy of expansion envisaged with the formation of **Lancashire Dynamo Group Sales Ltd.,** the Lancashire Dynamo Group announce the opening of a new sales and service office in Ipswich which will be the means of providing improved facilities to customers of all companies in the Group. The territory covered from this office will include Suffolk, Norfolk, Cambridgeshire, Huntingdonshire and the northern half of Essex and the address is 12, Princes Street, Ipswich (Ipswich 56141/2). **Mr. B. L. Perkins,** B.Sc., A.M.I.E.E., has been appointed manager of the Eastern Area office, and he will have a fully-qualified engineering staff. Mr. Perkins, who commenced his engineering career with Lancashire Dynamo & Crypto Ltd. in 1928, relinquished his position as general sales manager of Foster Transformers Ltd. (a Lancashire Dynamo group company) at the end of last year in order to take up his new appointment.

* * *

**The Fisher Governor Co. Ltd.** are now to include in their range of control valves the well-known Continental butterfly-valves. A new leaflet (E-7900A) describes these as powered by conventional Fisher diaphragm motor operators, but it is pointed out that they are available for lever, handwheel or chain-wheel operation.

* * *

A contract has been awarded by the Central Electricity Generating Board to **The English Electric Company Limited** to supply a 15-circuit duplicate busbar switching station for Hinkley Point nuclear power station, Somerset. The order, worth some £980,000, covers the generator, feeder, station transformer and bus coupler circuits, as well as 14-7,500 MVA air-blast circuit breakers, with associated control and relay panels.

**Swan, Hunter and Wigham Richardson Ltd.** and **The Nuclear Power Plant Co. Ltd.** announce that they are entering into collaboration for the design and construction of nuclear-powered ships. Swan, Hunter and Wigham Richardson Ltd., who have shipyards and engine works both on the Tyne (at Wallsend and Walker) and on the Clyde, have recently completed a 38,000-ton deadweight tanker, and will shortly be embarking on the construction of tankers of 65,000 tons deadweight. The Nuclear Power Plant Co. Ltd. was formed in 1955 by eight companies, several of whom played a major part in the design and construction of the Calder Hall nuclear power station and they are at present building the Bradwell nuclear station in Essex. As mentioned elsewhere in this issue, they also are to build a nuclear power station in Italy.

* * *

**W. H. Allen Sons & Co Ltd.** have received an order from the G.E.C. (London) for epicyclic gear units as part of that company's motor-driven centrifugal compressor plant for installation at the National Aeronautical Establishment, Ottawa, for the Canadian Department of National Defence. Two speed-increasing gears are involved, one of 11,000 h.p., and the other of 3,600 h.p. capacity. The gears will be mounted in the pedestals supporting the motor/compressor bearings, and will increase the motor speed of 1,200 r.p.m. up to a final compressor speed of 10,000 r.p.m. The epicyclic gear units will be manufactured at W. H. Allen Sons & Company's Atlas Works, Pershore, Worcestershire.

* * *

**Mr. D. Bignold** has been appointed Midlands and Eastern Counties technical sales representative for machine tools of Newall Group Sales Ltd.

G

# Latest Power Plant Patents

*These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)*

## Boiler with controlled steam temperature

This patent relates to steam superheaters and reheaters as utilised in thermal power plants operating under a single or double reheat cycle. The invention is specifically concerned with a method for controlling the temperature of the superheated steam and the reheated steam generator over a wide range of steam load. The boiler shown in Fig. 1 comprises a furnace (F) bounded by walls lined with water-cooled steam generating tubes (W). Fuel and air for combustion enters the furnace (F) through burners (B). These burners may be

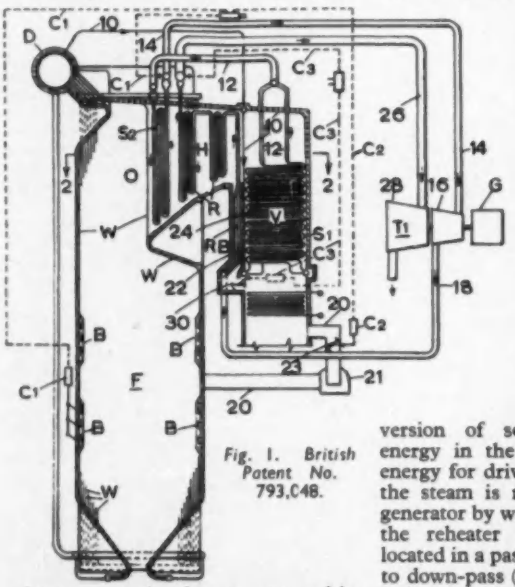



*Fig. 1. British Patent No. 793,048.*

of any conventional type, mounted in the furnace corners, or mounted in any one of the walls of the furnace. The steam generated in the furnace wall tubes is collected in a steam and water drum (D) to which are also connected the upper and lower ends of the furnace tubes (W) for water circulation. The hot products of combustion, after having given up a portion of their heat content to the furnace tubes (W) for the generation of steam, leave the furnace through gas outlet (O) and pass through a gas chamber comprising a gas pass (H) arranged for the flow of gases at right angles to the furnace axis, and an adjoining gas-pass (V) through which the gases flow downwards on their way to the chimney (not shown). Saturated steam collected in drum (D) is delivered via tubes (10) to a low-temperature superheater section (S1) located in the down-pass (V). The steam is partially heated by flowing through the tubular elements of section (S1) and is then discharged via conduit (12) into the high-temperature section (S2). This section is located in the gas-pass (H) adjacent to the furnace outlet (O). The partially heated steam is brought to its final temperature by flowing through the gas heated tubular elements of section (S2). From the superheater (S2) the superheated steam, also called "primary steam" to distinguish it from reheated or secondary steam, is then passed via pipe (14) to the high-pressure stage (16) of a steam turbine (T1). After conversion of some of the thermal energy in the steam to mechanical energy for driving the generator (G), the steam is returned to the steam generator by way of pipe (18) entering the reheater booster section (RB) located in a pass (22) arranged parallel to down-pass (V) and separated from it by partition (24). The reheater booster section (RB) is connected at its outlet to the main reheater (R) arranged within the gas-pass (H) on the downstream side (with respect to gas flow) of the high-temperature superheater section (S2). The reheat steam receives its final heating by flowing through the tubular elements of reheater (R) from where it is then delivered by way of pipe (26) to the low-pressure stage (28) of the steam turbine (T1). Damper (30) located within the pass (22) shuts off the gas flow over the reheater booster section (RB) at design load. Opening of the damper (30) at low loads permits gas to flow through the booster pass (22). Thus, the products of combustion additionally deliver heat to the reheater booster (RB) in the gas-pass (22), and thereby at lower loads boosts the steam temperature leaving the reheater (R). The pass (22) is so located with respect to the reheater (R) that some of the reheater elements extend, as shown, into the pass (22) to form the reheater booster (RB). This arrangement provides a design which is characterised by having a minimum resistance to steam flow. The furnace (F) may be equipped with the burners (B) arranged at different elevations so as to permit differential firing to control the heat content of the gases at the furnace outlet (O). Alternatively, gas recirculation may be resorted to for the same purpose, by drawing gas out of the lower portion of the gas-pass (V) by way of duct (20) and fan (21), and feeding these gases into the furnace (F) preferably at a point remote from outlet (O). A damper (23) controls the quantity of gases thus returned to the furnace. *British Patent No. 793,048 issued to Combustion Engineering Inc. Complete specification published April 9th, 1958.*

## Steam and gas turbine power plant

This invention relates to combined steam and gas turbine power plants in which the useful net output of the power plant is generated by steam turbines and special means are employed to transfer into the steam portion of the cycle all excess power generated in the gas turbine portion of the cycle. As the temperatures and pressures employed in conventional steam turbine power plants have approached the maximum possible with available materials and design techniques, increasing attention has been given to the advantages to be obtained by combining steam turbine cycles with gas turbine cycles, in various ways. One particularly interesting feature of such combined plants is the so-called "pressurised boiler" in which steam is produced by hot combustion products generated at atmospheric pressures in the order of 50 to 100 lb./sq. in. The use of such a high-pressure heating medium

results in greatly improved heat transfer to the water. At the same time it permits a very substantial reduction in size of steam generator combustion chambers and heat-exchangers. It has previously been suggested that the high-pressure combustion air required for such a steam generation process be supplied by an air compressor driven by a gas turbine using as its motive fluid the

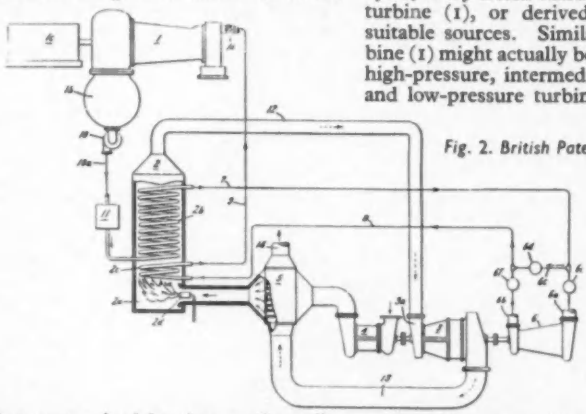
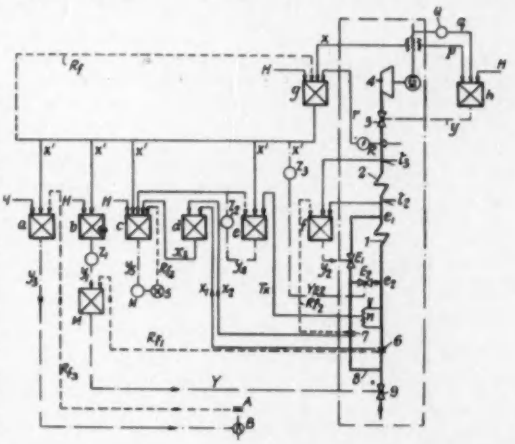


*Fig. 2. British Patent No. 793,294.*

hot pressurised heating medium discharged from the steam generator. However, the efficiency of the modern gas turbine has been improved to the point where it is capable of delivering much more mechanical energy than that required to drive the air compressor. Therefore the problem arises of how to make most effective use of this extra energy. In a plant arranged in accordance with the invention, and shown in Fig. 2, the steam generator (2) includes the combustion chamber (2a) and two separate heat-exchangers (2b and 2c). The first heat-exchanger (2b) is the primary steam generating element and discharges substantially saturated steam at a pressure of approximately 1,000 lb./sq. in., and temperature of 550 deg. F. through pipe (7) to the inlet (6a) of the steam compressor (6). The outlet (6b) of the steam compressor is connected by a pipe (8) to discharge steam at a pressure of approximately 1,300 lb./sq. in. and temperature of 600 deg. F. to the inlet of the secondary heat exchanger (2c). The outlet of this heat-exchanger is connected by a pipe (9) to discharge steam at approximately 1,200 lb./sq. in. and a temperature of 1,000 deg. F. to the inlet of turbine (1), which, of course, will be provided with suitable control valve gear indicated diagrammatically at (1a). Spent steam is returned to the liquid state in condenser (1b) and transferred by a boiler feed pump (10) to the inlet of the primary heat-exchanger (2b) by way of a pipe (10a). It will be appreciated that numerous conventional components of steam power plant have been omitted from Fig. 2. Illustrated diagrammatically at (11) is a feedwater heater, supplying water at temperatures in the order of 250 deg. F. to the heating coil (2b). In an actual plant, the single feedwater heater (11) might be an "economiser" heated by waste heat from the gas turbine portion of the cycle, or by steam extracted from the turbine (1), or derived from other suitable sources. Similarly, the turbine (1) might actually be a number of high-pressure, intermediate-pressure, and low-pressure turbines, in series, arranged in any suitable manner, with or without reheating between turbines. The gas turbine portion of the cycle is arranged as follows. Pipe (12) supplies spent heating medium from the steam generator (2) at a temperature of approximately 1,400 deg. F. and at a pressure some 2 per cent. to 5 per cent. less than the air compressor discharge pressure to the inlet (3a) of the gas turbine (3). Exhaust conduit (13) conveys the hot gases, which may still be at a temperature of the order of 1,000 deg. F. to heat-exchanger (5) which serves as a preheater for the pressurised combustion air. The combustion products are discharged through stack (14) which may have associated with it additional heat-exchangers to transfer thermal energy to the feedwater, or extract for other useful purposes heat remaining in the combustion products. For control purposes, a by-pass pipe (6c) is provided between the steam compressor inlet (6a) and the outlet pipe (6b). This by-pass has a valve (6d). Additional shut-off valves (6e and 6f) may also be provided for positively preventing the circulation of steam through the compressor (6) when by-pass valve (6d) is open. *British Patent* 793,294 *issued to General Electric Company, Schenectady, U.S.A. Complete specification published April 16th, 1958.*

*Fig. 3 (below). British Patent No. 793,341.*



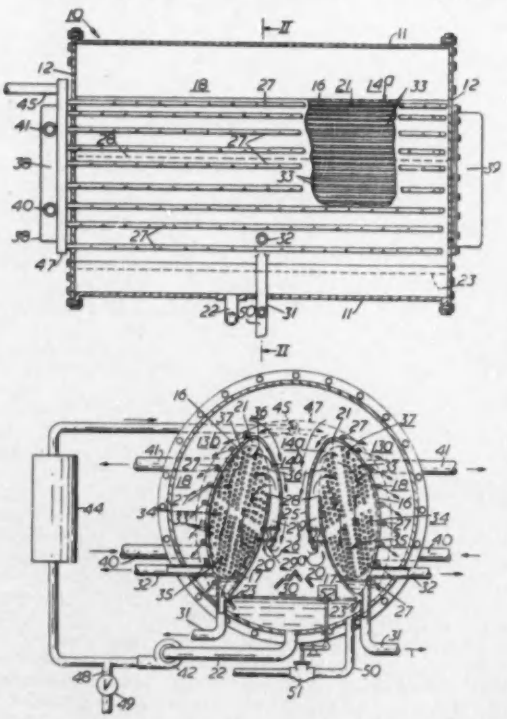
**Control of a forced-flow once-through boiler**

In the case of a once-through boiler, the difficulty of adapting the output to the load on the boiler with sufficient rapidity when load fluctuation occurs is due to the inertia of the firing control, and the time taken by the feedwater to pass through the forced-flow tubing system. The load-dependent regulating quantity (related to steam pressure, generator output, or frequency) can be very rapidly derived from the changed load, but its effect is very greatly delayed so that pressure and temperature fluctuations occur in the steam at the boiler outlet. A known and proved method of regulation for a forced-flow boiler involves feeding the quantity of water to at least two different points in the through-flow system. The main supply is fed in accordance with the load on the boiler, while a supplementary supply of water is injected into the superheater, in accordance with the steam temperature. In connection with the following description it is immaterial whether one or more temperature-dependent injection points are employed. The sole important fact is that it is a question of the temperature regulation at these injection points, which are thus regulated in accordance with the temperature. The question now arises of how the inertia of the firing can be compensated for in the case of an increase in load. It will be assumed that the load has increased by 10 per cent. and the rate of supply of the feedwater has been adjusted to a correspondingly higher amount through the boiler load-determining means (load-setting device), and the

feedwater regulator. The fuel supply will also be assumed to have been correspondingly increased, but it cannot take effect with sufficient rapidity owing to the inertia of the firing arrangement. The result of this would be a reduction in the steam temperature. The available quantity of steam would also be insufficient to meet the increased load owing to the length of time required for transit of the water through the tubing. The consequence would be a reduction in the boiler pressure. The temperature reduction could probably not be compensated for by reducing the temperature-dependent injection. The temperature regulation proposed according to Fig. 3 operates as follows. It will be assumed that the load of the generator (G) increases. The boiler load-setting device (g) then imparts adjusting impulses (x') to the regulating devices (a,b, and c) in such a manner as to bring about an increase in the steam output of the boiler. The action of the water regulation is delayed by the time-delay element ($Z_1$) (although this element is not essential) until the rate of firing corresponds to the increased quantity of water which will be required to meet the new load. Deviations in the temperature at the auxiliary heating surface (n) are transmitted to the regulator (e) (signal Tx) and from this to the coal regulator (c). Deviations of the superheating temperature at the measuring points ($t_2$) and ($t_3$) are transmitted through the temperature regulator (f) to the valve ($E_1$) in order to produce the most constant possible live steam temperature by variation of the quantity injected at ($e_1$). The separate regulating circuit for maintaining a constant draught in the furnace has been omitted from the diagram for the sake of clarity. The injection at the point ($e_2$) is controlled in accordance with the load by the boiler load-setting device (g) and the signal indicated by ($Y_{E2}$). Proceeding with the assumed case of the load increase, ($E_2$) then receives an order for a wider opening from the load-setting device (g). Thus, the quantity injected at ($e_2$) is increased and the quantity of steam entering the succeeding superheater (1) is accordingly also increased in accordance with the foregoing observations. The increased quantity of water injected at ($e_2$) in response to the increase in load is, in effect, phase-advanced with respect to the increase in the supply of feedwater and is evaporated with absorption of heat from the tube system. A further consequence of this is that the temperature decreases at the measuring points ($t_2$) and ($t_3$), and the temperature regulator (f) reduces the quantity injected at ($e_1$). The control order imparted to the valve ($E_2$), however, must not be maintained throughout the duration of the increased load but must become ineffective when the increased quantity of feedwater has advanced to the injection point ($e_2$). Since the times of transit through the system are known, it is sufficient to cancel the control order to the valve ($E_2$) by means of a time delay element (z). *British Patent* 793,341 *issued to Siemens-Schuckertwerke A.G. Complete specification published April* 16*th*, 1958.

**Flash evaporating and condensing system**

Figs. 4, 5, 6, and 7 show a combined flash evaporator and condenser. In operation water is withdrawn from the shell (11), and with the air off-take pipes (32) connected to a suitable means of maintaining a low absolute pressure, and with water supplied to the spray pipes (27) at a temperature higher than the boiling point corresponding to the pressure maintained in the shell, a portion of the spray will be vaporised. The spray is vaporised in the vaporising sections (18), and the vapour is circulated upwards and downwards through the nozzle (26), into the vapour collecting sections (21) by means of the passages (29). It then circulates downwards around the condenser tubes (33) and is chilled. Condensate formed in the vapour collecting sections (21) drops to the bottom of the sections and can then be withdrawn through the condensate outlets (31). Air separated



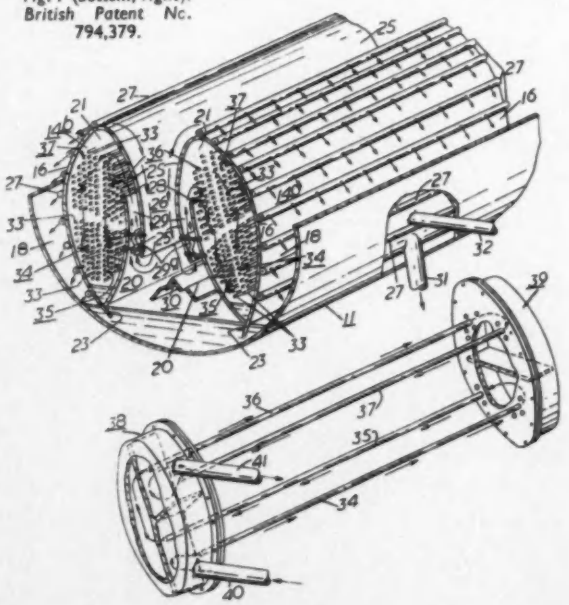


*Fig. 4 (top, left). Fig. 5 (bottom, left). Fig. 6 (top, right). Fig. 7 (bottom, right). British Patent No. 794,379.*

from the condensate is removed through the air off-take pipe (32). The condenser portions (14a and 14b) may be identical. The tubes (33) are arranged in four bundles or passes (34, 35, 36, and 37) and communicate with a pair of water-boxes (38 and 39) attached to the end plates (12) of the shell. The water-box (38) is provided with an inlet pipe (40) and an outlet pipe (41). As shown in Fig. 7, in which only one of the tubes (33) of each pass is included the water-boxes (38 and 39) are partitioned to permit water from the inlet (40) to pass from one portion of the water-box (38) through the first pass (34) to the water-box (39). The water then passes through the second pass (35) to another portion of the water-box (38). From here the water flows through pass (36), i.e. the third pass, back to water-box (39). It then passes through the pass (37), which constitutes the fourth pass and back to water-box (38) and finally to the outlet pipe (41). As indicated by the directional arrows, the vapour flows upwards upon entering the vapour collecting section (21) and then reverses direction and sweeps downwards past the third and fourth passes (36 and 37), respectively, and then past the cooler first and second passes (34 and 35), respectively. With this arrangement, condensate dropping through the condenser portion is cooled to the lowest degree. *British Patent No. 794,379 issued to Westinghouse Electric International Company. Complete specification published April 30th, 1958.*

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**W. H. Allen Sons & Co. Ltd.,** Bedford, have been awarded a contract by the Admiralty for the supply of motor-driven main dock and drainage pumping plant for H.M. Dockyard, Rosyth. The plant will comprise two mixed-flow vertical-spindle pumps driven by synchronous induction motors through intermediate shafting, together with associated pipework, switchgear and cabling. The main pump, with 52-in. dia. branches, will be designed to deliver 66,000 gal./min. of sea water against a head of 53 ft. and to operate at heads up to a maximum of 86 ft. The drainage pump, with 22/20-in. branches, will deliver 10,900 gal./min. against a head of 60 ft. and operate with a maximum head of 96 ft. The main dock pump will be driven by a 1,425-h.p. duct-ventilated synchronous induction motor, operating on an 11-kV, 3-phase, 50-cycle supply, and the drainage by a 270-h.p. duct-ventilated synchronous induction motor with an 11-kV/415-volt unit transformer. Both the motors and transformer will be manufactured by Bruce Peebles & Co. Ltd., who are the main electrical sub-contractors.

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**Lancashire Dynamo & Crypto Ltd.** are supplying equipment totalling more than 60,000 h.p. for Bradwell nuclear power station. Lancashire Dynamo equipment is in operation in a large number of power stations in this country, and in many other parts of the world. One of the most recent and advanced thermal stations, at Castle Donington, is equipped with numerous Lancashire Dynamo motors, as well as transformers and switchgear. It is this experience, combined with the wide range of complementary products manufactured, which places the Group in a strong position to serve the growing requirements of nuclear power development. From an early stage Group Companies have supplied special equipment for nuclear research, and they are now designing and building machines of progressively higher output for operation in nuclear power stations. Equipment of even higher output is now being manufactured for the Bradwell Station. Specially-designed Lancashire Dynamo motors will drive the main gas-circulators which carry out the vital function of transferring heat from the reactors to raise steam for the turbines. The first of these machines, of which twelve are to be installed, developing an output of 4,400 h.p. at 3,300 r.p.m. has we understand already been manufactured and officially accepted.

Over one million barrels per day is the total quantity of oil processed by some 40 oil refineries insulated by **Newalls Insulation Co. Ltd.** in more than 20 different countries. This impressive record of world-wide activity is being featured on an illuminated world map as one of the main displays on the Newalls stand at the Chemical & Petroleum Engineering Exhibition at Olympia, June 18th-28th. An extensive range of Newalls (Reg'd. Brand) insulation products which the company manufacture and apply for an operating temperature range of from —300 deg. F. up to over 2,000 deg. F. is being featured in a special illuminated display including Newalls latest introduction, Newalls (Reg'd. Brand) Newtherm calcium silicate insulation—a tough, versatile insulation particularly suitable for refineries and chemical plant. Also on display will be various insulated pipes showing different types of insulation finishes, and high-temperature insulating bricks for use in boiler furnace walls and floor construction.

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A few weeks ago the Minerva Works of **Electroflo Meters Co. Ltd.,** Abbey Road, Park Royal, N.W.10, was set aside exclusively for the construction of instrument panels, instrument cases and appropriate welding facilities. The new works is completely self-contained, and, occupying some 24,000 sq. ft. of space, it is claimed to be the largest factory in the United Kingdom making instrument panels.

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**Associated Electrical Industries Ltd.** have organised a training scheme for officers leaving the services as a result of recent defence cuts. Prepared in conjunction with the Officers' Association on behalf of the Regular Forces Resettlement Service, it provides a two-year course for between 110 and 180 officers over the next 4-5 years. The scheme has been designed primarily to equip officers, with no technical qualifications, for employment in the electrical engineering industry. A.E.I. cannot guarantee to employ all who undergo this training, although every effort will be made to do so. Pay will be at the minimum rate of £575 per annum during the first year and £650 during the second year of training. Applications for training should be made to the **Officers' Association,** Windsor House, 46, Victoria Street, London, S.W.1, or to any local office of the Ministry of Labour and National Service and not to A.E.I. Ltd.

**Babcock & Wilcox Ltd.,** have issued a new publication entitled "Babcock Nuclear Engineering." This 40-page illustrated brochure describes the company's activities concerning research, design, manufacture and installation of nuclear power station plant. Babcock & Wilcox are responsible for the supply of all the steam-raising equipment for Calder Hall A & B atomic power stations, and also for similar stations at Chapelcross in Scotland, totalling 32 steam-raising units. The contract awarded to the English Electric-Babcock & Wilcox-Taylor Woodrow Atomic Power Group for the construction of the 500-MW atomic power station at Hinkley Point in Somerset, marks a notable advance in the design and construction of a nuclear power plant. The contribution of Babcock & Wilcox Limited to this new and vast undertaking includes the design and construction of both the reactor pressure-vessels, and also of all the steam-raising units. This recently issued brochure also includes some notes of B. & W. activities in the field of nuclear ship-propulsion, and on the company's atomic energy department in London, and the research department at Renfrew.

* * *

A £400,000 contract awarded to **Crompton Parkinson Ltd.**—as recently announced by the Development Board of the Government of Iraq — is for the supply, delivery, erection and commissioning of switchgear and transformers for a power station at Basrah, and municipal substations at Jubaila and Basrah. The Basrah power station, designed for the Development Board by Messrs. Ewbank & Partners, Engineering Consultants, London, for a generating capacity initially of 45-MW, has provision for its ultimate extension to 150-MW. Power produced by this station will later be linked by 132-kV overhead transmission to other areas of southern Iraq.

* * *

**The British Engineers' Association** held its annual luncheon in London on Thursday, April 24th, with Sir Edward Thompson, the president in the chair. The principal guest was Viscount Chandos who spoke after the luncheon about some of the problems of the proposed European Free Trade Area. One of the important considerations Viscount Chandos said, was whether a member-country would have the right to take steps to protect its currency at a given exchange rate. It would be impossible, he asserted, to have free trade, without free exchange.

# NOTES Personal AND Industrial

Owing to the responsibilities devolving upon **Mr. C. R. King, C.B.E.,** as deputy-chairman of the Central Electricity Generating Board, he has been compelled to relinquish the chairmanship of the National Inspection Council for Electrical Installation Contracting. **Mr. A. F. Plummer,** M.C., Associate I.E.E., managing director, Shoolbred Electrical Co. Ltd., has been elected to succeed Mr. King, who will, however, continue his board membership as representing the C.E.G.B. Following upon his appointment as chairman of the Electricity Council, **Sir Henry Self,** K.C.B., K.C.M.G., K.B.E., has also found it necessary to resign from the National Inspection Board. **Mr. C. T. Melling,** C.B.E., M.I.E.E., etc., has been nominated as representative of the Electricity Council in succession to Sir Henry.

* * *

The Department of Scientific and Industrial Research states that **Mr. A. F. Seddon** and **Mr. R. C. H. Russell** have been appointed principal scientific officers at the Hydraulics Research Station.

* * *

**Mr. H. S. Davidson,** T.D., M.I.E.E., transmission engineer of the Midlands Division of the Central Electricity Generating Board, has been appointed divisional controller of the South Western Division of the Board. In 1930, Mr. Davidson was appointed section engineer in the Central England Area of the Central Electricity Board, and three years later became senior assistant transmission engineer. On his return from military service during the war, to, the Central England Area of the Central Electricity Board he became transmission engineer and took over similar duties in the Midlands Division on the reorganisation of the electricity supply industry in 1948.

* * *

**Mr. Sebastian Z. de Ferranti** has been appointed managing director of the heavy electrical engineering firm—Ferranti Ltd. **Sir Vincent de Ferranti** remains chairman of the company.

* * *

Bailey Meters & Controls Ltd., Purley Way, Croydon, announce that **Mr. G. Clay** has been appointed as their assistant sales manager.

* * *

Elliott Brothers (London) Ltd., announce the appointment of **Dr. L. L. Ross** as deputy managing director. **Rear-Admiral Sir Alexander D. McGlashan** and **Mr. J. E. O'Breen** have been appointed directors.

* * *

Metropolitan-Vickers Electrical Co. Ltd. announces the appointment of **Mr. L. H. J. Phillips,** B.Sc., A.M.I.E.E., sales manager, Electronics Department, as assistant commercial manager. **Mr. A. G. Barton,** Assoc.R.T.C. (Salford), A.M.I.E.E., succeeds Mr. Phillips as sales manager, Electronics Department.

**Mr. E. John Hunter,** B.Sc. (chairman, Swan, Hunter & Wigham Richardson Ltd.), has been elected President, and **Mr. George Bennet Halley,** B.Sc. (managing director, The Wallsend Slipway Engineering Co. Ltd.), and **Mr. Douglas Gordon Ogilvie,** B.Sc. (managing director, Hawthorn Leslie (Engineers) Ltd.), vice-presidents of the North East Coast Institution of Engineers and Shipbuilders.

* * *

Ruston and Hornsby Ltd., has announced the following appointments : **Mr. George Anselm,** export manager for Europe, Africa and all Middle East territories ; **Mr. Kenneth Wickham,** export manager for the Far East and Australasia, and **Mr. John Bennett-Powell,** export manager for Canada, U.S.A., and South America.

* * *

**Mr. W. Stainsby,** B.Sc.(Hons.), A.M.I.Mech.E., A.M.I.C.E., education officer of **Electroflo Meters Co. Ltd.** (member of the Elliott-Automation Group) has been elected chairman of the Education Sub-Committee of the British Instrument Makers and Control, Appliance Manufacturers Association (B.I.M.C.A.M.).

* * *

**Mr. R. F. Farmer,** assistant secretary of Incorporated Plant Engineers since 1952, has been appointed secretary of the Institution in succession to **Mr. Hadleigh S. Seaborne.**

* * *

The British Thomson-Houston Company announce that **Mr. F. C. Barford,** T.D., M.I.E.E., has relinquished his position as manager, Birmingham District, following his recent appointment as manager, Small Industrial Machines Department, Blackheath, Birmingham. He is succeeded by **Mr. K. J. Clarke,** A.M.I.E.E., who moves from Sheffield District where he has been manager since October, 1957. **Mr. W. J. Wilson,** A.M.I.E.E., manager, Leeds District, succeeds Mr. K. J. Clarke as manager, Sheffield district, and **Mr. J. N. Griffiths** has been appointed manager, Leeds district.

* * *

As the result of the further enlargement of their Machine Tool Division, **Newman Industries Limited,** Yate, Bristol, announce that **Mr. F. Barton** has joined the company as technical representative in the Lancashire and Cheshire areas. He will operate from the Newman Manchester office.

* * *

Philips Electrical Ltd. announce that **Mr. S. G. P. de Lange** has relinquished his responsibilities as commercial manager of the Industrial Products Division, and is appointed adviser to the company and co-ordinator in all matters affecting industrial products. He is succeeded as commercial manager by **Mr. C. W. V. Davis,** at present manager of the Filtration Department.

**Mr. H. H. Gott,** M.A., A.M.I.Mech.E., chief engineer, Reactor Design, in the Industrial Power Branch of the Atomic Energy Authority, has been appointed Nuclear Plant design engineer of the Central Electricity Generating Board. Mr. Gott joined the Ministry of Supply at Risley in 1946 as technical engineer working on gas-cooled reactors. As chief technical engineer he was concerned with the Windscale reactors and the Capenhurst plant before becoming assistant chief engineer on the Fast Reactor project. With the initiation of the nuclear power programme he was appointed industrial liaison engineer for the Atomic Energy Authority and was promoted to his present post as chief engineer in January, 1957.

* * *

**Mr. J. Basil M. Mason** recently retired from the board of Judd Budd Limited in order to devote his whole time to industrial consultation regarding the use of solid and liquid fuels in industry, both in the United Kingdom and abroad.

* * *

**Mr. Granville Horsley** has been elected to the board of Crofts Engineers (Holdings) Limited, Bradford. He has also been appointed as joint managing director of the operating company, Crofts (Engineers) Limited.

* * *

A course on **The Control and Instrumentation of Reactors** is to be held at the Harwell Reactor School from October 6th to 11th, 1958, inclusive. The fee for the course will be 25 guineas exclusive of accommodation. Application forms and further details can be had from The Principal, Reactor School, Atomic Energy Research Establishment, Harwell, Berkshire.

* * *

**Sulzer Bros. (London) Ltd.,** 31, Bedford Square, London, W.C.1, states that their telephone number has been changed to Museum 7890. The address of the company's heating and ventilating division has been changed to 12, Dyott Street, London, W.C.1 (telephone Covent Garden 3381).

* * *

**Elliott Brothers (London) Ltd.** states that its power plant division has moved to larger office premises adjacent to its associate company, James Gordon and Co. Ltd., Dalston Gardens, Stanmore, Middlesex (telephone, Wordsworth 0269). The move covers sales, projects, and contracts office ; only the engineering and production sections remaining at the Lewisham works.

* * *

**Matthews & Yates Ltd.,** Swinton, Lancs., have placed an order with **Heenan & Froude Ltd.,** Worcester, for ten Heenan air-coolers for use in the ventilation arrangements of the Ilgner sets, and the main mill drive motors, of Stewarts and Lloyds' new rolling mills at Bilston.

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# soot blowing

## is a push-BUTTON job

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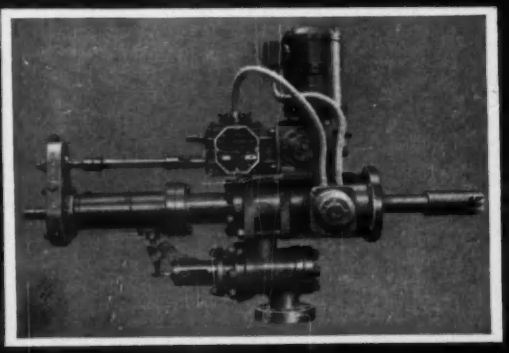

THE BLOWER: The complete operating cycle is in one motion and is driven through a compact mechanism by a non-reversing motor. When the operating shaft is rotated, the nozzle advances, the steam ports open and, at the same time, rocking motion is automatically transmitted to the nozzle. The uni-directional motor eliminates the bulky contactor gear used with reversing motors and reduces electrical maintenance by being of simpler and more rugged construction.

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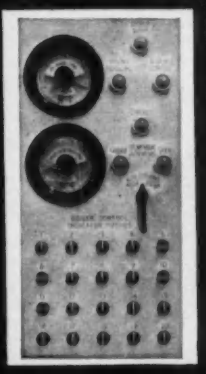

AND THE CONTROL PANEL
Simple controls to operate the automatic sequence are grouped on this small unit which takes up little space on the main boiler control panel.

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41/A

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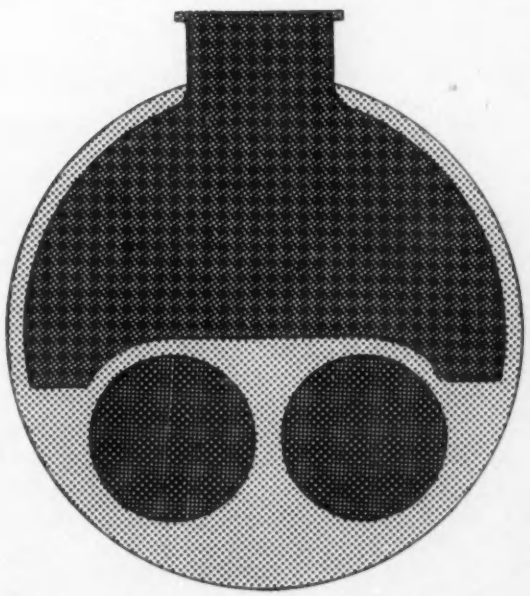

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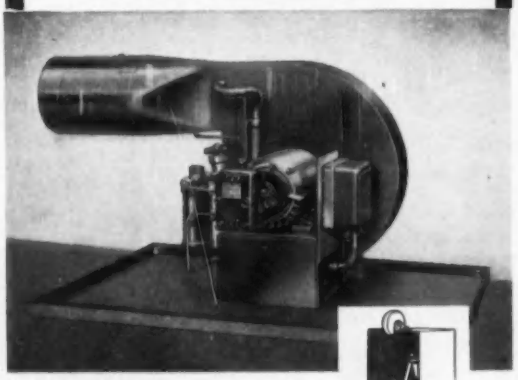
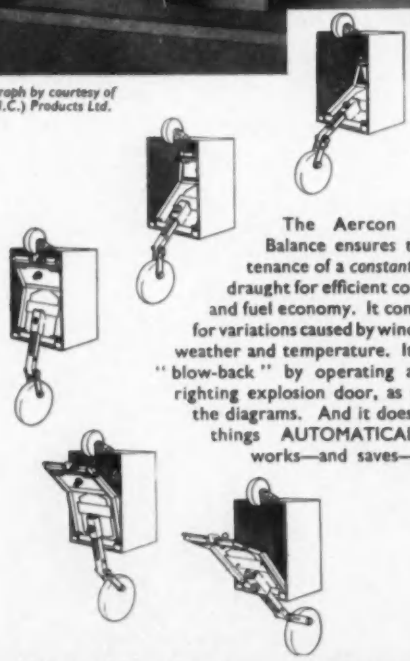


*Photograph by courtesy of Riley (I.C.) Products Ltd.*



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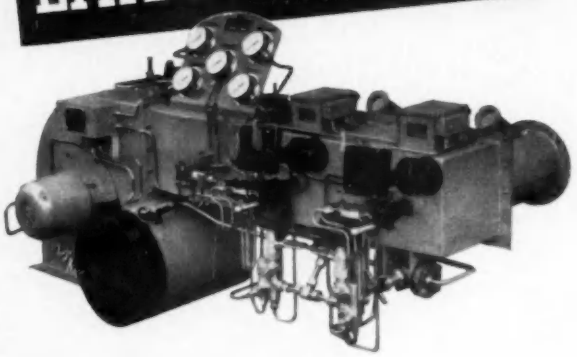

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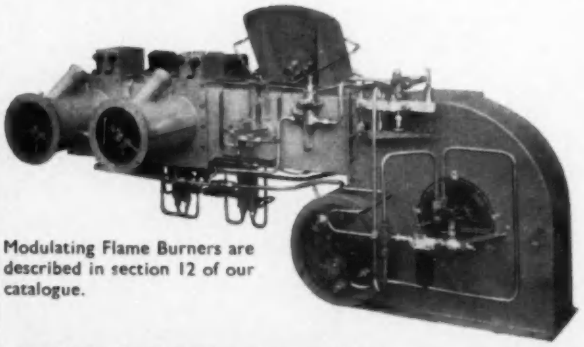

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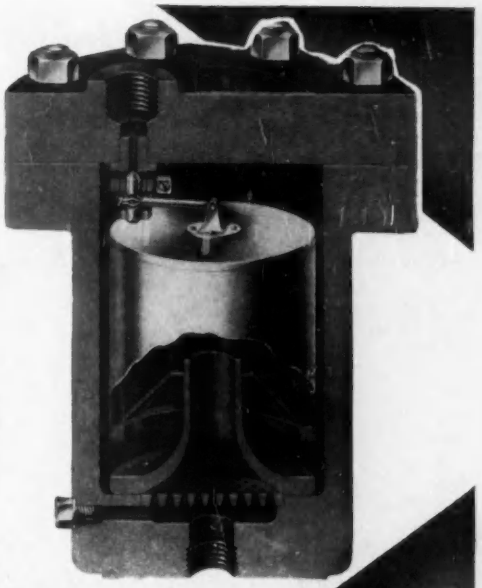

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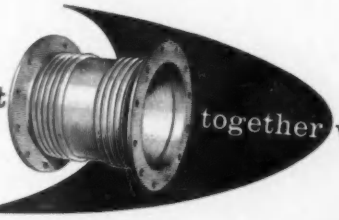

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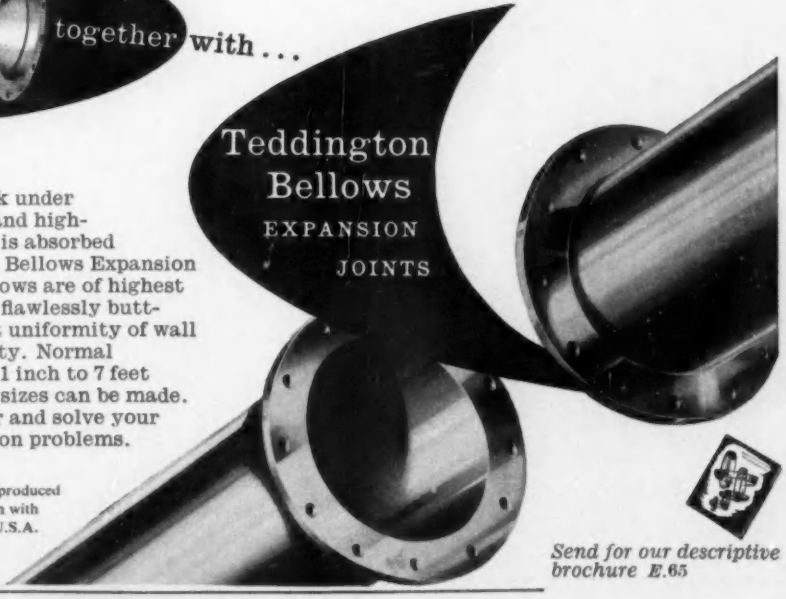

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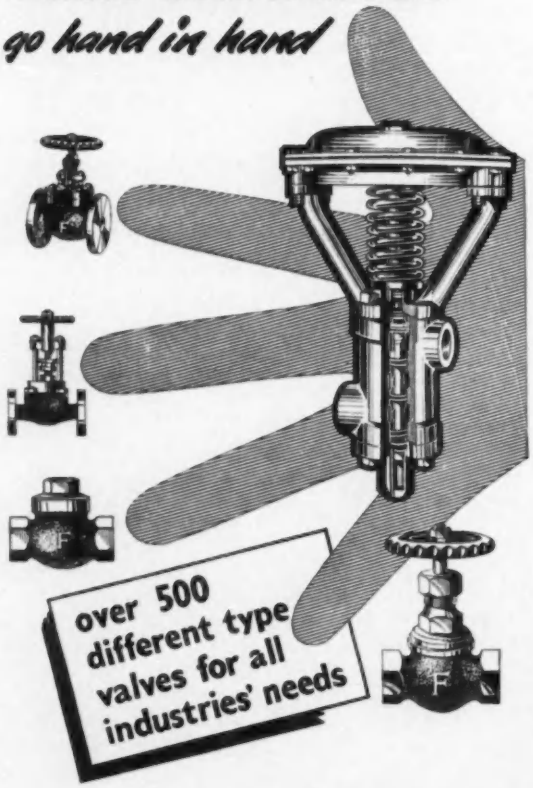


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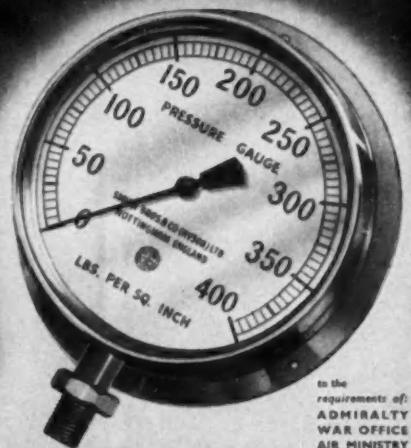


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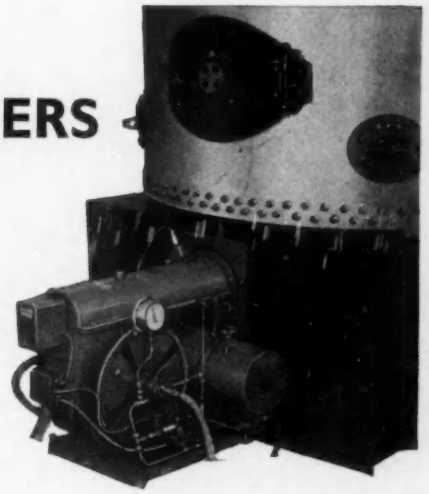

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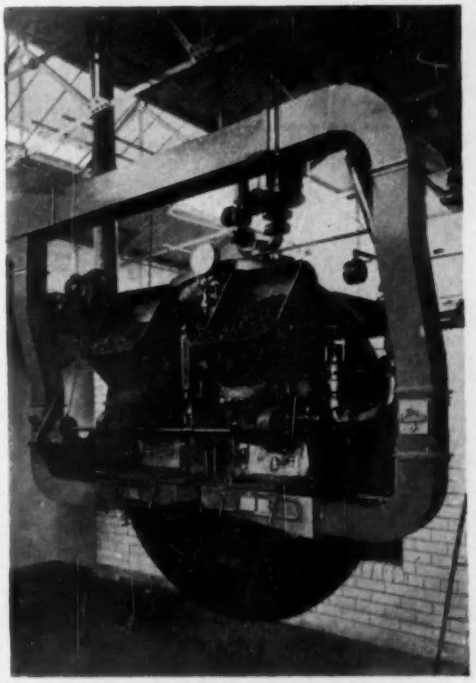

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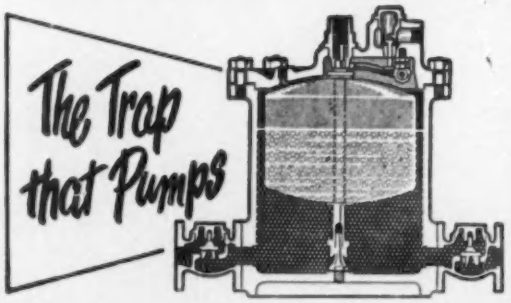


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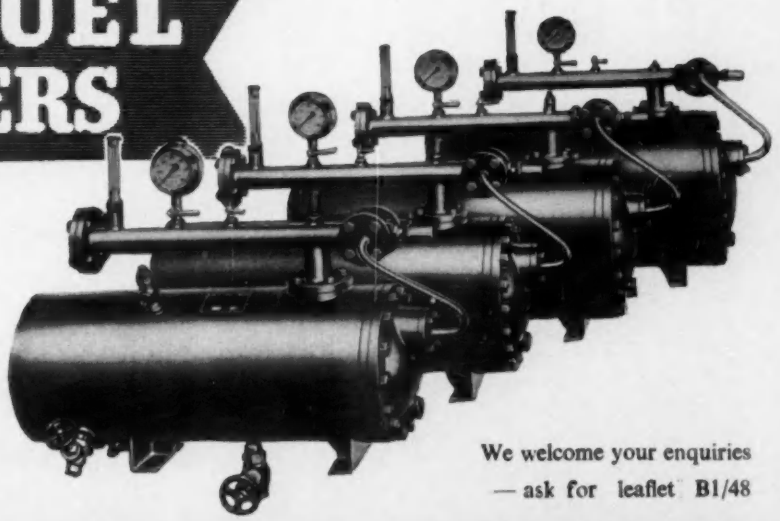

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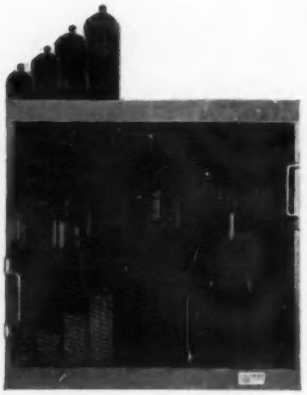

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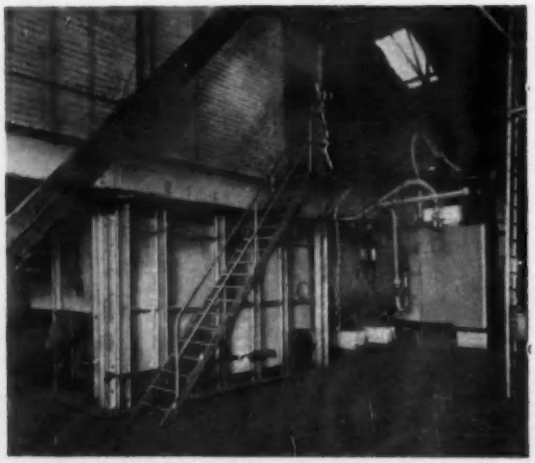

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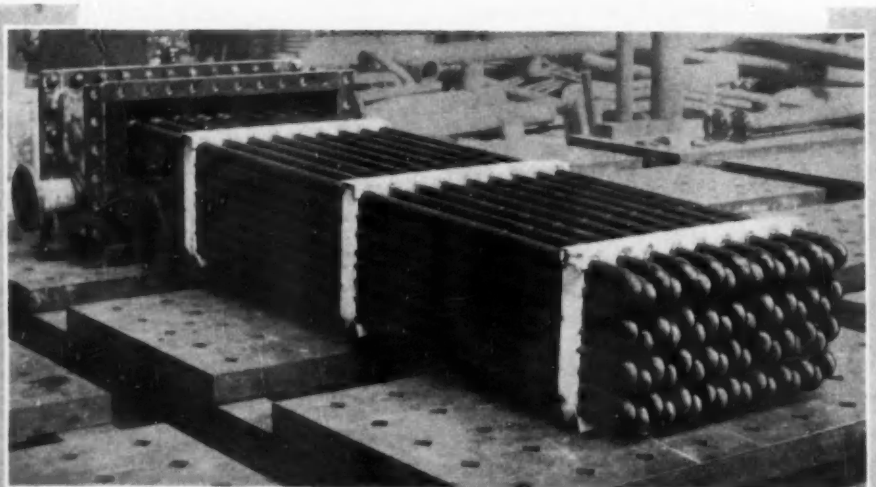

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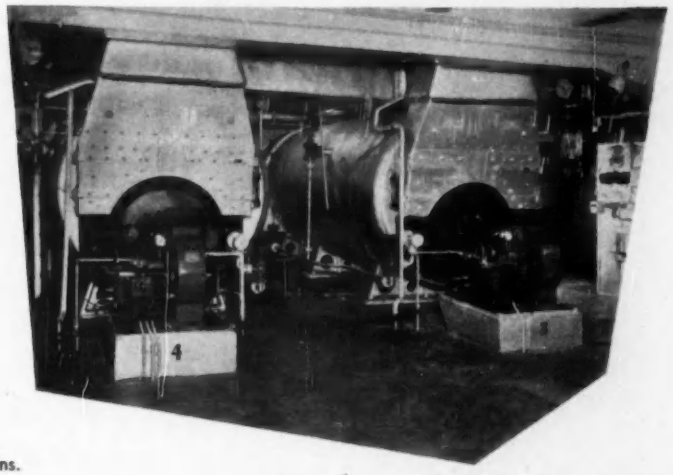

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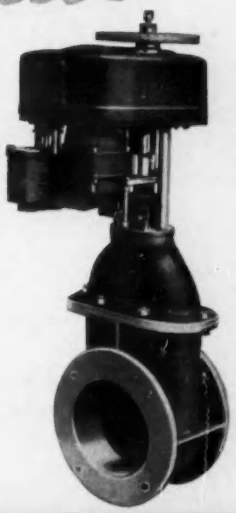

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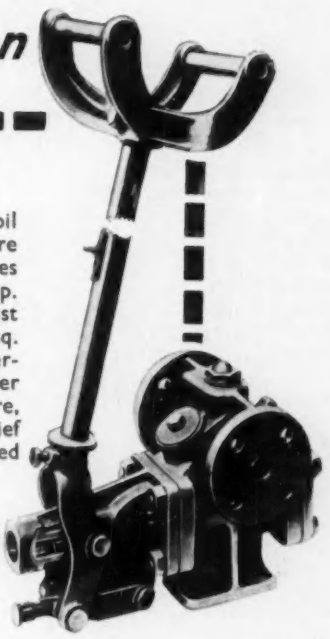

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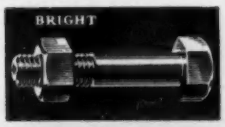

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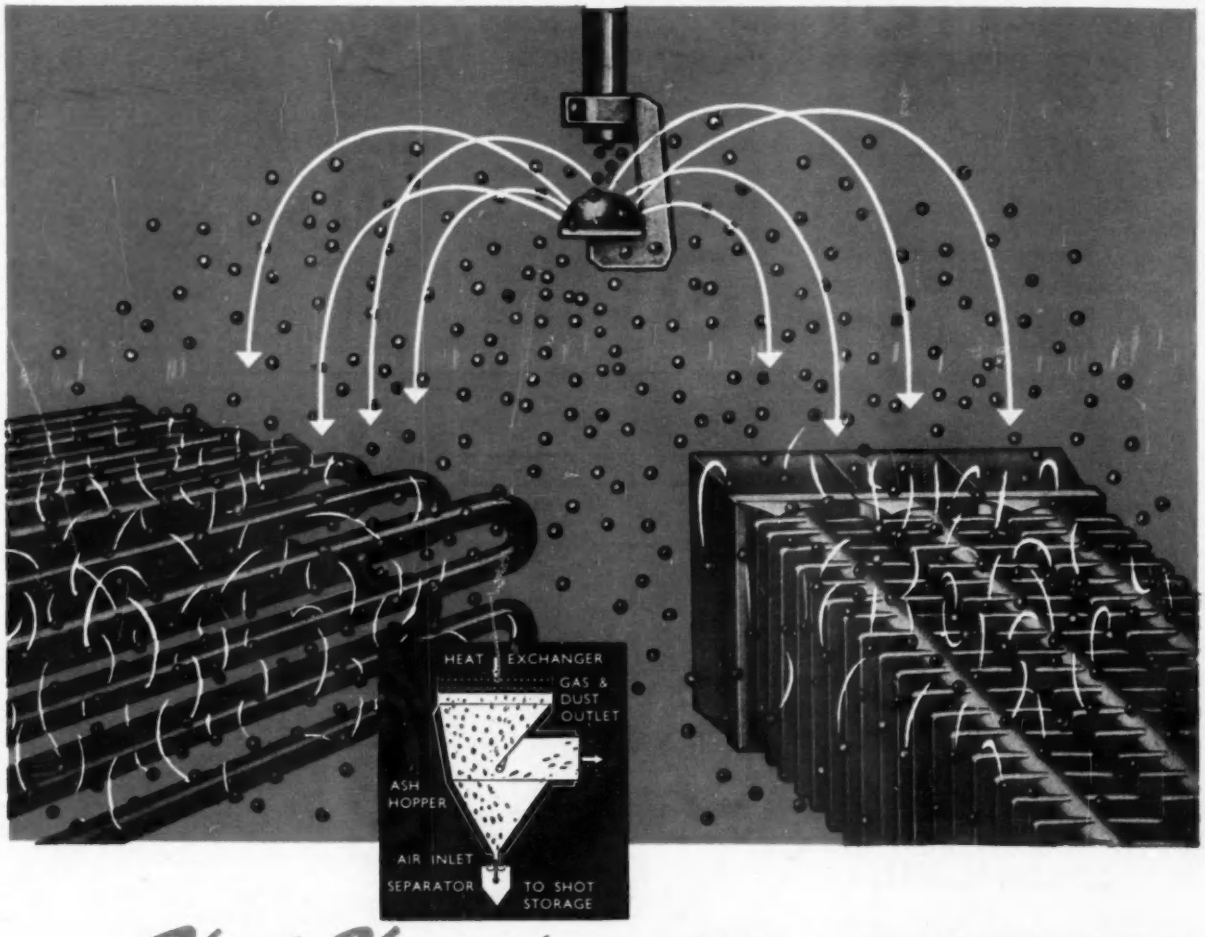


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